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VISIT TO THE BIG TREES OF *MARIPOSA AND TO* THE YOSEMITE VALLEY, CALIFORNIA, AMERICA.

EARLY in June last, I started from San Francisco in order to visit the renowned big trees of Mariposa, as well as the far famed Yosemite valley, which are both situated in the Sierra Nevada mountains about 200 miles south-east of San Francisco.

After crossing the bay of San Francisco by means of a fine ferry boat, I took train and proceeded to a place called Raymond, distant about 200 miles in a south-eastern direction, and which place is at present the nearest terminus for travellers *en route* for the big trees and for the Yosemite valley.

For the first 175 miles, or as far as the Berenda station, the line runs through an undulating and well cultivated country dotted over with numerous neat farms. All the fields are well fenced, wheat appearing to be the principal crop cultivated, and at the time of my visit the harvest was just commencing. This part of California is hot and somewhat dry, and subject it is said to severe droughts, but efforts are now being made to utilize the water of several of the rivers for irrigation purposes, by means of a system of canals in the same way as has been done in some parts of India.

As a matter of course, all natural forest has been cleared in the neighbourhood of the railway, but near all the stations along the line, and round about the farms, fine groves of a species of Eucalyptus have been planted, and the trees seem to be flourishing.

As expected, I found the system of travelling on the American railways most luxurious, the Pulman cars running very smoothly, and the carriages provided with double windows to keep out the dust.

Several cars in each train are also fitted with sleeping accom-

modation of the most complete kind, and in all carriages there is always a reservoir of pure iced water.

As far as my experience went, I only found dining saloon carriages attached to trains west of the rocky mountains, but great care is always taken in America when passengers cannot obtain refreshments on board the trains, to time the arrivals at the bouffets at suitable hours.

The next morning about 7 A.M., I arrived at the railway terminus of Raymond, which was found to consist of a temporary wooden shanty and tents pitched in the middle of the jungle. After breakfast and various anxious enquiries on the part of the more nervous of the travellers as to the probability of meeting with brigands *en route*, we started in open cars drawn by six horses for Wa-wa-ona, or the big tree "ranche," which is the nearest hotel from which the mammoth trees can be visited.

The first part of the road for a distance of about 12 miles, runs through an undulating country much resembling certain portions of Central India, after which, the base of the Sierra Nevada mountains is reached, where the country becomes more hilly and picturesque. The road is unmetalled, and as there had been no rain for two or three months the dust was quite appaling.

The geological formation appeared to be mica schist, and this part of California contains a fair amount of gold, and one or two mines were passed which were said to be flourishing.

About 25 years ago, when the mania for gold digging in California was at its height, this portion of the country was the scene of much excitement and disappointment to those in search of the precious metal, and numerous pits and scratchings are everywhere visible, all over the valley and hill sides. The vegetation of the country lying between the railway and the foot of the Sierra Nevada mountains is somewhat of a dry and stunted nature, and consists of the following trees and shrubs, the scientific names of which I have not been able to discover. Willow pine, a large tree resembling the *Pinus longifolia* of Northern India ; white or live oak, buck-eye, a large bush with beautiful bunches of white flowers, also what appeared to be several species of *Rhus*.

Amongst flowering plants I observed lupins, larkspur, *Clarkia*, sunflowers and blue bells, as well as many other European species.

On ascending the slopes of the Sierra Nevada mountains, most of these species disappear, and the yellow pine, the bastard cedar, began to appear, as well as a beautiful species of *Cornus*, also a shrub called *Mansanita*. This bush has peculiar red bark and pink bell-shaped flowers, and the wood is much appreciated for walking sticks.

About 15 miles from the railway terminus we crossed a branch of the Merced river, along the edge of which a "flume,"

or timber slide, has been constructed by the Californian Timber Company, the bed of the stream being rocky and water sometimes scarce, which renders it unsuitable for floating purposes. This Company is said to have purchased from Government 15 years ago about 50,000 acres of pine and cedar forest, at 5 dollars, or about £1, per acre, and the object of the slide is to facilitate the exportation of the timber from these forests to the railway.

The total length of the slide is 58 miles, the upper depôts being situated in the Sierra Nevada mountains, whereas the lower depôt is at Madera on the railway line. From the casual glance I obtained of it *en route*, this slide appeared to be constructed of 2 inch planks throughout, the section being 2 feet at the bottom and about 3 feet at the top.

The planks or beams are fixed into sleepers, which are either embedded in the ground or supported on trestles whilst crossing ravines. The gradient appeared to be very slight, probably not more than 1 foot in 100 feet, and as the supply of water is scarce, great care is taken by careful jointing and caulking to prevent all leakage.

The curves are very wide, so that scantlings 28 feet in length are said to be exported with ease. This slide has been at work for 8 or 10 years, and is said to be a financial success to its present owners, but a former Company by whom it was built failed.

About 1 P.M. we arrived at White Sulphur Springs Hotel, 23 miles from the railway, where after vainly endeavouring to get rid of the dust which had rendered some of the travellers hardly recognisable, we indulged in luncheon, and then started about 3 P.M. for Clark's ranche, situated 12 miles further up the mountain, but which, owing to the hilly nature of the road, we did not reach till 6 P.M.

En route we passed several clearings in the forest devoted to the cultivation of fruit, such as grapes, apples, pears and peaches, which industry is now a thriving one in California.

The grapes are made into wine, which is of a very fair description, and the other fruits are exported under the name of canned or tinned fruits, and have now obtained a wide reputation for cheapness and excellence of quality all over the world. The part of California where fruit gardens have been most successfully established is in the neighbourhood of San Louis Obispo, situated about 200 miles south of San Francisco.

In this vicinity, a few years ago, good land could be purchased at rates varying from £2 to £5 per acre, and many energetic men having a slight knowledge of fruit culture, who started 8 or 10 years ago with small capitals of say £500, are now said to be reaping handsome profits varying from £30 to £50 per acre.

Clark's "ranche," the meaning of which latter term is apparently station, consists of a clearing in the middle of the forest,

where an extensive hotel and other buildings have been established, this being the place from which the Mariposa grove of big trees can be most conveniently visited.

The next morning after considerable difficulty, a guide was found, who in consideration of a moderate gratuity of $2\frac{1}{2}$ dollars, or about 10 shillings, agreed to accompany me on foot to and from the big trees, which trip necessitated a walk of about 12 miles.

Before recording my personal observations on the big trees of Mariposa, a few general remarks in accordance with the latest opinions of the best American authorities regarding these far-famed curiosities of nature, may not be out of place here. The aggregate area occupied by the *Wellingtonia*, or *Sequoia gigantea*, is supposed to be about 50 square miles, the region in which this species is principally found, and which appears to be its most congenial habitat, being comprised between the King and Kaweah rivers.

This tract of country is situated about 200 miles east of San Francisco in the Sierra Nevada range of mountains, which may be considered a branch of the Rockies. There are said to be only eight or nine patches of the real *Sequoia gigantea* scattered on this area, the altitude at which the species is found varying from 5,000 to 7,000 feet. The geological formation is generally granitic, the soil in the places where the big trees are found being deep, and in such places there is always a good supply of water in the form of springs or small streams.

The big trees were discovered in the year 1855, when the tales told of their gigantic dimensions seemed almost incredible, one of which is the well known "Yankee" story, *viz.*, that they were so high that "it took two men and a boy to see to the top of them." The traveller's tales regarding the height and dimensions of these trees have, however, now been considerably modified, and after careful measurement, it is found that the tallest tree is one in the Calavaras grove, which measures 325 feet, whereas one of the trees having the greatest girth at the base is probably the "Grizzly Giant," situated in the Mariposa grove, the girth of which is 92 feet, though another tree is said to exceed 100 feet. These dimensions are of course enormous, but it may be noted that they are exceeded by the *Eucalyptus Amygdalina* of Australia, which has been found to attain 480 feet in height, and in girth, by the Baobab tree (or *Adansonia digitata*) of Africa, which sometimes measures as much as 100 feet in circumference.

The *Sequoia gigantea* generally grows associated with the following species—Yellow pine (*Pinus ponderosa*), sugar pine (*Pinus Lambertiana*), white cedar (*Libocedrus decurrens*), white fir (*Picea grandis*). At first, it was thought that, these trees must naturally belong to some remote geological era, and were probably contemporaries with the mammoths and mastedons, but

after a careful examination and counting of the annual rings on the sections of several felled trees by various eminent botanists, it has been clearly established that the greatest age of these giants does not exceed 1,500 years, which after all is probably not much more than that of some English yew trees.

The number of trees over 50 feet in girth in the different groves varies from 50 to 400 or 500, and besides these, there are numerous other trees of all sizes and ages.

It is also stated that, throughout the nine clumps of *Sequoia gigantea* there are numerous young "big trees," so that there is no reason to suppose that the species is dying out.

The thickness of the bark is remarkable, and some pieces observed by me exceeded 24 inches, whereas in a small museum attached to Clark's Hotel I saw a piece having a thickness of 36 inches.

As regards my personal observations on the trees of the Mariposa grove, which was visited by me on the 5th of June last, the following are the principal notes made on that occasion :—

After leaving Clark's Hotel, we marched through a fine forest of sugar and yellow pine, mixed with a large proportion of white cedar, as well as a considerable number of black oak (*Quercus nigra*).* The undergrowth consists of various shrubs, amongst which the dogwood (or *Cornus Nuttallii*) was most conspicuous, it being in full bloom at the time of my visit.

I noticed another most conspicuous plant, *viz.*, what appeared to be a kind of ground orchid about 2 feet high, the whole plant being of a bright red colour.

The geological formation of this part of the Sierra Nevada consists of whitish granite, and the soil appeared to be deep and of good quality. All these forests belong to the American Government, except where special grants have been made to squatters, and to Mining or Timber Companies. A nominal control only is exercised over the remainder, except where the big trees are situated, which areas are reserved under the name of public parks.

Traces of extensive forest conflagrations were everywhere observed, and in former years, these fires were lighted by the Indians in order to clear the undergrowth and thus facilitate 'shikar' operations, but at present the fires are generally said to be due to the carelessness of shepherds, immense flocks of sheep from the plains of California being driven up during the hot weather to browse in these hill forests. After proceeding for about 4 miles through the forest, the slopes of which are gentle, the mean gradient being about 25 degrees, we struck the carriage trail about a mile from the big trees. The big trees of the Mariposa groves, the total number of which over 30 feet in girth is about 50, and situated in two groups called the upper

* Probably *Quercus agrifolia* or *Douglasii*.—[ED].

and the lower groves, the altitude varying from 6,000 to 6,500 feet. The area containing the big trees, the extent of which is stated to be about 2 square miles, is reserved under the name of a public park, and is in charge of a Board of Commissioners, which body appears to be a kind of local committee.

A set of rules prohibiting felling, firing, injuring, &c., have been drawn up, the penalty attached being 500 dollars and six months' imprisonment, or both. Nothing is said about sheep grazing, nor could I find any traces of demarcation, so that the arrangements are not very complete at present. These groves occupy what may be called the bottom and lower slopes of a series of small valleys, having generally a northern aspect, and are well sheltered by the surrounding hills and thick forests from all winds and tempests.

The soil is deep and consists of decomposed white granite and quartzite with a thick layer of vegetable mould. On approaching the groves from Clark's, the first trees encountered are the "Sentinels," then the "Three Graces," afterwards the "Grizzly Giant," all the principal trees having special names, which are written up in large letters.

Notwithstanding the fact that, the big trees are surrounded by yellow and sugar pines of an average height of about 200 feet which naturally hide them, still their appearance is most imposing, and they can fairly be compared to towers or to church steeples.

The tree having the greatest circumference in this grove is the "Grizzly Giant" above referred to, which at the base I found to be 92 feet in girth, but the height does not exceed 230 feet, the top having been apparently broken off by the wind. This tree is much injured by fire, and the base has probably flanged out in consequence, so that the original girth at the ground probably did not exceed 70 feet.

Various other trees I found to be of almost equal dimensions, notably the "Faithful Couple," or double tree, and apparently sound, which measures 90 feet at the base, also one of two trees called the "Twins," in the hollow inside of which, 17 persons on horseback can be accommodated.

The tallest and soundest trees I observed growing in a small well watered valley, just below the forest ground or custodian's hut.

Here the trees are straight and well grown, and the stems sometimes run up to 120 feet without a single branch.

Another remarkable tree is one situated highest up of all, and through which an archway about 18 feet wide has been cut. The forest driving track is led through this opening, and all tourists visiting the big trees of course specially note this as one of the most interesting sights, and the picture of this tree figures in a prominent manner in all the American advertisements. Throughout these groves I hardly noticed a single tree which was not more or less injured by fire, and I am certain that it is

only due to the great thickness of the bark of the *Sequoia gigantea* that a great deal more damage has not been done.

Nevertheless many trees have doubtless perished from this cause, and numerous half burnt trees and stumps are to be found scattered throughout the groves, and one tree which still remains standing, called the telescope tree, has its inside completely burnt out up to about 90 feet, and the top having been broken off, daylight is visible whilst looking up from below.

I observed comparatively little moss on these trees, which testifies to the dryness of the climate, the average rainfall being, as far as I could ascertain, about 25 or 30 inches only. Mr. Cunningham, the custodian of these groves, has lived for many years in this neighbourhood, and inhabited the Yosemite valley long before the advent of tourists. He amused us with many entertaining and romantic tales of the Indian inhabitants, and their doings in the good old times.

At his hut we purchased various curios, such as pieces of wood, bark, &c., and then retraced our steps by a different route to Clark's ranche, after a very pleasant day spent amongst the big trees of Mariposa. The next morning, we started in a car drawn by six horses for the far famed Yosemite valley, the distance from Clark's ranche being 25 miles.

The drive over a somewhat rough road was through the same kind of forest as those already described, traces of conflagrations being everywhere visible.

These forests are not, however, regularly burnt like those in some parts of the Himalaya, for which reason, certain portions probably escape for a number of years, and in such places I noticed a considerable number of seedlings, principally of the white cedar, springing up. On reaching what is called "Inspiration point," situated about 18 miles from Clark's ranche and 7 from the Yosemite valley hotels, the first glimpse of this famous valley is obtained, some idea of the grandeur of which may be gathered from a description given in one of the guide books, a quotation from which I shall give here. "The fame of the Yosemite has become world wide. Its towering cliffs, waterfalls like cataracts from the clouds, and the gigantic vegetation surrounding it have no comparison in the world.

"In sublimity of character and enchanting beauty it surpasses expression, and must be viewed to be appreciated.

"Several eminent writers have attempted descriptions, but all have despaired in giving the awe-inspiring feeling which fill the beholder of the mighty chasm."

The Yosemite valley, the meaning of which is the valley of the grizzly bear, is situated at about 4,000 feet above sea level, and various theories exist with regard to its peculiar physical formation. The average height of the surrounding *Sierra Nevada* range of mountains varies from 8,000 to 10,000 feet, and the most probable theory is that at the time of their upheaval the

Yosemite portion collapsed, as the peculiar form and extremely steep sides cannot be accounted for in any other satisfactory manner. The geological formation is the usual white granite of the Sierra Nevada, and a lake probably occupied the bottom of the valley at one time, which gradually became drained leaving the Merced river meandering throughout its length.

The Yosemite valley is about 6 miles long with an average breadth of one-third to one mile, and along the bottom the Merced river flows in a picturesque and placid manner, forming small lakes and pools all along its course, the borders being shaded by groves of various kinds of trees.

The valley is surrounded on all sides by gigantic cliffs and precipices, the principal of which are El Capitan, which presents an almost perpendicular face of 3,000 feet, the Cathedral spires, the North Drome, the Sentinel rock, &c., all of which tower from 3,000 to 4,000 feet above the valley.

From various points all round this peculiar ravine numerous waterfalls, fed by the melting snows of the Sierra Nevada, pour down their waters to join the Merced river, there being in all eight main falls and as many smaller ones.

The principal waterfall is the "Bridal veil" fall, which is first seen in entering the valley, the vertical height of which is 940 feet, and a fine view of which is obtained as soon as Inspiration point is reached.

The next most striking cascade on the left hand side of the valley is the Yosemite fall, close to which the hotels are situated, and which descends 2,600 feet in three successive falls, the perpendicular height of one of which is 1,600 feet.

At the head of the valley, the Nevada fall is the most striking, the vertical height of it being 700 feet, and the volume of water probably 60 feet wide, and 10 feet deep. The quantity of water in the other falls referred to is somewhat less than this, but in most of them, owing to their great height, even vaster bodies of water are dashed into spray before they reach the basin below. The Yosemite fall is by far the finest in the valley, and the thunder of its waters may be heard from a distance of several miles.

The best season to see the waterfalls of the Yosemite, in their full beauty, is from the 15th of April to the 15th of June, at which time the melting of the snow takes place. There are three good hotels in the valley for the accommodation of the numerous travellers, and besides these, there are a limited number of private houses, most of which were built before the valley was constituted a public park or reserve, but the building of new houses is now prohibited.

In addition to the American population, which probably does not exceed 200 permanent residents, there are a few Red Indians, who are generally employed as farm servants, but a few of them cultivate small farms.

The vegetation of the Yosemite consists principally of the yellow and sugar pine, together with a fair proportion of the bastard cedar.

Various other species, such as maples, alders and oaks are common, but the *Sequoia gigantea* or mammoth pine does not exist in an indigenous state. The undergrowth consists principally of azalias, various kinds of cornus, barberries, ferns, &c. The climate of the Yosemite valley is subject to considerable variations of temperature, and during the winter, the waterfalls are sometimes frozen, and snow lies to a depth of 2 or 3 feet for several months. During the summer, the temperature is hot and close, and at the time of my visit, the thermometer stood at 85 degrees in the shade.

The following are the principal animals found in the neighbouring Sierra Nevada mountains, grizzly bears, which sometimes attain considerable size, the skin of one seen at Clark's Hotel measuring 8 × 9 feet, and the brown and cinnamon bears, which are smaller animals, and probably about the size of the Himalayan black and brown bears.

These animals are by no means common now, nor is the Puma or mountain lion which is now nearly extinct.

Wild dogs, foxes and skunks are still fairly common, but wild pigs are now rarely met with, in this part of California. The American elk, the moose, and a species of *Ovis Ammon* have now almost disappeared, but are still to be found towards the north, in Montana and other of the northern States. The wild bison has disappeared from this part of America, and is now only found in Mexico, Texas, Wyoming and Montana.

A fine driving road traverses the Yosemite valley on both sides of the Merced river, besides which, there are numerous footpaths leading to the waterfalls and to most of the surrounding accessible peaks.

One of the most interesting excursions is to what is called the Glacier Point and Sentinel Dome, situated 3,000 and 4,000 feet respectively above the valley, and from which a magnificent view of the valley and surrounding mountains can be obtained.

The walk from the hotel, a distance of about 8 miles, is a pretty stiff one for those unaccustomed to mountain climbing, so that nearly every one rides.

The Glacier Point is a projecting rock which overlooks the valley, and from which a stone may almost be dropped for about 3,000 feet without touching the face of the precipice.

The view from the Sentinel Dome, situated about a mile further up the hill, is grand and imposing, most of the waterfalls being visible, and a magnificent panorama presents itself of the Yosemite valley and surrounding peaks of the Sierra Nevada mountain, many of which were capped with snow, the intervening valleys being thickly clothed with pine forests.

As regards my personal opportunities for comparing the scenery of the Yosemite valley with that of other mountains, I may observe that I have seen as fine individual cliffs elsewhere, especially in the Himalaya, but nowhere probably is it possible to find such a collection of stupendous peaks, precipices and magnificent waterfalls all concentrated into a limited area of about 6 square miles.

E. McA. M.

THREE DESCRIPTIONS OF THE STATE FOREST

THREE DESCRIPTIONS OF THE STATE FOREST OF TRONCAIS (ALLIER).*

The State Forest of Tronçais, in the north of the Department of the Allier, contains an area of about 26,250 acres, or 41 square miles of High Forest. If we add to it the forest of Civrais, only a few hundred yards distant, the entire wooded area comprises close upon 30,000 acres, or 47 square miles; a magnificent property.

Tronçais contains about 3,000 acres of old high forest, where a great number of fine old oaks, aged from 150 to 225 years, are still standing, reckoned amongst the finest oaks in France, and yields the best class of staves.

The revenue of this forest in 1885, amounted to 4,45,000 francs (Rs. 1,78,000), about 18 francs (Rs. 7·2) per acre, a fairly good figure in these days, when it is the fashion to say that, our department gets no return from the State forests, forests give no revenue, and it would be better to convert them into arable or pasture land. We know several agricultural proprietors, who farm their lands most carefully, and yet obtain less than 8 or 12 francs per acre. They would look upon 18 francs an acre, as an altogether unhoped for result.

It is well worth while becoming acquainted with this fine forest, and considering whether its management by the State Forest Department has not been attended with the very best results.

Official luck has given me the charge of the forest of Tronçais, and I have been obliged to look up some of the old papers relating to its former condition. Indeed, to speak fairly, these papers were handed over to me by the distinguished Conservator at the head of the 21st Circle, who will not contradict my assertion that he loves forests, and particularly the forest of Tronçais. The only trouble I have taken has, therefore, been to read and to copy.

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* Translated from a paper by M. Desjobert in the "Revue des Eaux et Forêts, 10th November, 1886."

For it is merely the three descriptions of the forest of Tronçais, of 1670, 1832, another made partly in 1868, and partly in 1883, which will be given.

Let me add that the figures, which I give, are not more accurate than the matter requires; and are only intended to show the relative importance of the different standing crops.

The description of 1670.

This is by Florimond Huart, Chevalier, Seigneur of St. Denis, Privy Councillor, and President of a Commission of enquiry into the forests of France in the provinces of Orleans, Blois, Tours, Poitiers, Bourges and Moulins, and by Jean Leféron, Privy Councillor and Commissioner for improving the above mentioned forests.

The Tronçais forest contains in one block, 18,600 arpents, with 2,000 arpents adjoining. It is situated on a soil fit to bear high forest up to the age of 200 years, as we have ascertained, both by an examination of the soil and of the fine oak trees *in situ.*

The greater part of the area is stocked with old oaks of 150, 200, and 300 years, for the most part branchy, stag-headed and dying, relics of former fellings standing in compartments entirely ruined, without a single seedling or coppice shoot; the balance of the area, however, is well stocked with mature oak forest.

Then follows the description of the compartments, but we have thought it better for comparison to give these in smaller type, alongside their later descriptions in 1832, 1868 and 1883.

Description of 1832.

This is by M. de Buffévent, and is followed by a highly interesting report by M. Lorentz, after which a royal decree of the 24th April, 1835, decided that the central part of the forest (section B of 9,250 acres) together with 850 acres of the Garde de La Bontiolle, should be regenerated in 60 years.

All the remainder of the forest was placed under preparatory treatment with a view to its future management under the system of high forest with thinnings.

At the same time, it was ordered that all the blanks should be re-stocked with conifers.

From M. de Buffévent's description of the compartments, we gather that section B, comprising 9,250 acres, was then composed of a high forest of oak and beech, with stag-headed hornbeams.

The crop was here and there, throughout the area, interrupted by very damp blanks covered with broom, gorse and heather, but the reserved trees were very fine and aged about 200

to 300 years, while the beech from seed were extremely fine, those from coppice shoots being on the decline.

The rest of the area consists of 8,460 acres of stored coppice of beech and oak, of 2,660 acres of blanks resembling those in section B, and of 6,700 acres of high oak and beech forest, in which the beech was dominating.

Description of 1868 and 1883.

We find two recent descriptions of the forest, the one made in 1868, by the 7th Working-plan Commission, consisting of MM. Soumain, Buffault, Bernard and Marbaret; the other only applying to areas where the estimated yield (*possibility*) of the forest was being revised, and dated May 1883, drawn up by M. Fabre, under M. Galmiche's orders.

This last description has been adopted, wherever it exists, and in default, *that of 1868.*

The new compartments have been included in the old ones of 1670, in order to allow for comparison, and the descriptions have been greatly curtailed.

The conclusions drawn by the Commissioners of 1670 were as follows :—

1. To reserve the 300 arpents of high forest.
2. Coppice in 33 years at the rate of 50 arpents a year the 1,660 arpents of old dying oaks.
3. Cut back the 16,340 arpents of old ruined fellings, where nothing remained but a few sapling oaks, and other trees spared by the wood merchants, under which in some compartments some hornbeam and a few seedling oaks existed. Ten of the best saplings were to be reserved per arpent.

These improvement fellings were to cover 80 years at the rate of 200 arpents a year, and to replace the ordinary sales of standing crop.

After 80 years of these fellings, the high forest system was to be re-introduced with a rotation of 90 years, at the rate of 90 *arpents per annum.*

Acorns were to be dibbled in amongst the heather and in the blanks.

All pasturage was to be excluded, and the forest surrounded by a ditch 8 feet broad by 6 in depth.

We have already given the prescriptions which resulted from M. de Buffévent's inspection, and by Government orders of the 17th April, 1869, the forest was subdivided into six high forest working circles, with rotations of 180 or 144 years, and this plan is now being followed.

The present forest staff consider that it would be advantageous to take 180 or even 200 years for the rotation of the six working circles.

Comparative Description of Compartments.

Name of Compartment.	Area.	1670.	Area.	1832.	Area.	1868 or 1883.
	Arpents.		Acres.		Acres.	
Bois Chavereau, ..	115	Fine oak high forest of 100 to 150 years.	250	Stored coppice. Beech predominating; crop here and there incomplete. Seedlings fairly numerous.	350	No blanks. 85 acres of fine Scotch pine; 40 years old.
	173	Old ruined coupes to be cut back.		The standards are too scattered, and are mostly crooked, stag-headed and unsound.		The remainder, oak and beech poles partly coppice shoots, in full vigour of growth; 100 years old.
			100	Blanks covered with heather, gorse, juniper and broom, containing here and there a few coppice clumps and dying trees.		
Garde de l'Armenauche,	2,960	The greater part of the area badly stocked with old oaks of 150, 200, and 300 years, mostly stag-headed and dying, the relics of former fellings.	2,325	Stored coppice, having the beech, generally from seed, as the predominant tree. The ages are irregular, comprising old trees on the decline and nearly	1,250	Poles of mixed species, oak and beech dominating, half old coppice shoots, rather scantily stocked. Growth middling. Age 90 years.

Name of Compartment.	Area.	1670.	Area.	1882.	Area.	1868 or 1883.
Garde de l'Armenauche, (*continued*).	Arpents.	The stock is ruined by cattle and sheep grazing, and by the forest being fired annually for fresh herbage. Forest offences have been allowed with impunity;	Acres.	all stag-headed; saplings from seed, younger than the surrounding coppice shoots; so that the crop resembles that of a forest treated by *jardinage*.	Acres. 1,250	Poles of oak and beech; crop regular, dense and promising; 90 years.
		300 arpents, of which half has been cut over in the last		The crop is also here and there interrupted by glades.	500 70	Fine pine poles; 40 years. Blanks.
		15 years, is entirely ruined and without a single coppice shoot. The crop should be cut back, all except the most promising trees, which will serve as	375	Deplorable condition, the soil entirely covered with a dense growth of heather, holly, junipers and gorse. A few old trees and some coppice clumps exist here and there.		
		standards for the regeneration of the compartment.	375	Coppice and isolated seedlings under a few very scattered trees.		
		Acorns must be dibbled in where necessary. There is at the Blancs Fossées a fine young		The crop is everywhere interrupted by blanks with heather, broom, holly and junipers, a few seed-		

		high forest of oaks of 100 years, which should be set aside for principal fellings and for the Naval service.		ling trees here and there. The reserves are very poor, and *those felled* in the last coupe have sent up shoots forming clumps *measuring* 4 to 7 metres in diameter.		
Garde de la Goutte Ardent.	1,500	Badly stocked with old deformed and stag-headed oaks of 200 to 300 years, with some beech of 50 to 100 years, under which we find hornbeam, birch and other soft woods. It is ruined by constant cattle and sheep grazing, by forest fires, and by the non-production of shoots after the fellings.	1,000	*Young coppice*, principally of beech. The standards are young and vigorous, and the crop promising.	650	Fine regular complete and dense crop of oak and beech poles, partly on stools, 70 years old; very promising; a few *old reserves*.
			625	Same as No. 2 of l'Armenauche.	537	Old coppice shoots, surmounted by numerous *standards of* 160 years, with vigorous young poles from seed, and some *old standards*.
			375	Same as No. 3 of l'Armenauche.	575	Scantily stocked with poles, half grown stools, oak and beech, the former predominating, middling growth; 75 years; with a mingling of splendid patches of Scotch

Name of Compartment.	Area.	1670.	Area.	1832.	Area.	1868 or 1883.
	Arpents.		Acres.		Acres.	
Garde de la Goutte Ardent—(*continued*).						pine from 10 to 40 years old, which cover about half the area.
					150	Blanks.
Garde du Meslier, de la Jarry et de Morat,	7,430	Covered with old ruined coupes. The crop has been destroyed by cattle and sheep grazing and forest fires.		This garde with that of Jarry and Morat form M. de Buffévent's section B.	833	Complete and promising seedling crop of oak and beech, 40 years old, with about 50 acres of blanks and glades.
		A few dying oak poles remain, which have been repeatedly burned.	9,250	High forest of oaks, mixed with beech and stag-headed hornbeam. The crop is everywhere interrupted by very damp blanks and glades covered with broom, gorse and heather.	550	Poles 30 to 40 years; mixed crop very promising on half the area; very slow growth on a fourth of it. 37 acres of fine young pine seedlings, and as much blank.
				Holly is common in the wooded parts. Patches of seedlings occur in the heather, generally incompletely stocked. Most of the beech are coppice shoots, and are	650	Seedling crop of 25 years, complete and promising, except in the hollows, where the young seedling crop, though complete, has suffered severely from spring frosts; 20 acres

				dying out, those from seed, on the contrary, are very fine trees.		of blanks sown up with pine.
				The standards on the last coupes are about 200 to 300 years old and very fine trees.	312	Complete well-grown crop of 40 years from seed; oak, beech and hornbeam.
				About 150 acres are to be re-stocked by the proprietor of the smelting furnaces of Tronçais, Le Sieur Rambourg, in exchange for forest produce.	190	Old oak high forest, under regeneration. Nine-tenths of the area covered with fine young seedling crop of mixed species, the oak predominating. One-third of the old trees are on the decline.
				The sowings have only succeeded on half the area, the remainder being covered with impenetrable heather.	62	Blanks.
					1,770	Old high forest of 180 years of the following types:— (*a*). Dense, regular, lofty, high forest of pure oak; undergrowth scanty, but abundant where sheep-grazing is excluded, and almost entirely wanting where it is allowed. (*b*). Regular high forest, forming a dense lofty crop, generally complete, but scanty here

Name of Compartment.	Area.	1670.	Area.	1832.	Area.	1868 or 1883.
Garde du Meslier, de la Jarry et de Morat—(*continued.*)	Arpents.		Acres.		Acres.	and there, over an undergrowth of beech and hornbeam in thicket, or poles from 20 to 30 years old. Thanks to the undergrowth, the high forest is still in fine condition, and shows no signs of deterioration. The phrase "*fine growth, very fine oaks*" constantly recurs in the description. For about one-tenth of the area we read: damp blank of so many acres, where the oaks are branchy and unpromising.
					1,375	Regeneration seed coupes generally described, as follows:— "Old scantily stocked high forest regularised by seed

						fellings, the standards branchy and not being sufficiently numerous to ensure reproduction." We may add that the exceptional acorn year of 1884 has since produced an abundant crop of seedlings everywhere. Blanks very rare.
					175	The results of le Sieur Rambourg's sowings. Pure complete regular oak poles, very promising. Beech has been planted as an undergrowth.
					3,250	Seedling crop 10 to 40 years old, complete, and very promising, thickets and poles, oak predominating. About 250 acres subject to attacks of spring frosts.
					75	Blanks.
Garde des Landes Blanches.	2,430	One-fourth of the area near Morat has been exploited in ruined coupes, which have	650	On most of the area, oak coppice from 3 to 20 years old, interrupted here and there by blanks	425	Fine pine poles; complete crop, with an undergrowth of mixed broad-leaved species. 45 years.

Name of Compartment.	Area.	1670.	Area.	1832.	Area.	1868 or 1883.
Garde des Landes Blanches—(*continued*).	Arpents.	been grazed down and injured by fire, with old dying and burned oaks, birch, hornbeam, aspen and other soft woods. The remainder near Pizégu, badly stocked with old oaks of 100, 200 and 300 years, dying and burned, under which are numerous hornbeam, and a few oaks and beech.	Acres.	owing to the stools being too old to coppice. The remainder; blanks and oak high forest very scantily stocked and on the decline. The soil is everywhere infested with under growth of injurious plants. Here and there we find a few planted or sown oaks. Stag-headed reserves here and there, over the coppice.	Acres. 1,975	Mixed poles, very promising on $\frac{4}{5}$ths of the area, and rather scanty on $\frac{1}{10}$th, the remainder very scantilystocked. About $\frac{1}{10}$th coppice. 45 to 75 years old. Everywhere in the description, we read "Fine straight poles, complete and promising crop."
					437	Old stored coppice of oak and beech with hornbeam on stools. Fine growth 65 years old.
		About 200 arpents grown in the best places have been exploited and jhumed and are now ruined by fires and grazing. The crop must be cut back, and the better trees reserved as standards, and acorns dibbled in the blanks.	560	The forest destroyed, for only a few scattered trees and patches of seedlings remain. The soil is covered with heather and gorse. The greater part is allotted as a temporary privilege for pasturing the cattle of the furnaces of Tronçais.	325	Plantations of different ages, generally promising.
					125	Glades.

			2,075	High forest fairly promising, over coppice shoots. The oak predominates, and is vigourous and *generally from seed.*		
			725	Same description as No. I. of Landes Blanches.		
Garde of Pizégu, ...	1,300	Old coupes entirely ruined, grazed down and partly burned. A few dying oaks from 200 to 300 years old remain, under which there are only a few birch and soft woods. Cut back, reserve the best trees, and dibble in acorns in the blanks.	275	Patches of oak seedlings, coppice shoots of the same species in clumps 5 to 9 metres in diameter with scattered trees. *The soil is for the most* part covered with heather, gorse, and brambles.	775	Irregular poles formed by old clumps, each bearing four or five poles, and surmounted by a few old standards, from 150 to 200 years old. About $\frac{1}{4}$th of the crop from seed. Cover nearly complete, and crop promising except in the blank hollows. 85 years old. (Most of the old standards have disappeared in the thinnings).
			750	Oak coppice mixed with soft woods, the whole scantily stocked, seedlings are scattered in the blanks, and the reserves generally stag-headed.	875	Scotch pine, oaks and some soft woods. 35 years. Fine promising young poles, the three kinds being generally mixed.
					100	Glades.

Name of Compartment.	Area.	1670.	Area.	1832.	Area.	1868 or 1883.
	Arpents.		Acres.		Acres.	
Garde de Montaloyer,	1,500	Same as above.	1,850	Same as first two of Pizégu.	700	Dense vigorous poles of Scotch pine with a few oak coppice shoots. An undergrowth of planted oaks and beech generally successful. 35 years.
					450	Old, and more or less open coppice of 70 years.
					275	Very complete plantation of oaks and pine. 5 to 20 years old.
					225	Fine, dense, vigorous poles from seeds, 60 to 70 years old.
					200	Blanks and glades.
Garde de la Bouteille,	3,300	The greater portion ruined, grazed and burned coupes of various ages.	1,350	Beech coppice, the clumps very scattered. Heather, holly and other hurtful plants are very abundant.	450	Fine well stocked pine poles, with a scattering of broad-leaved species. 35 years.
		A few dying oak standards remain, under which we find a few oaks, beech and hornbeam from 50 to 100 years old.	175	Coppice full of standards, from which natural reproduction may be expected.	1,300	Old stored coppice dense, straight poles generally from seed. The coppice shoots are nearly all from hornbeam. Very promising. 75 years old.
			1,125	High forest with beech predominating. The		

	We must cut back, preserve the best standards and dibble in acorns in the blanks. About 300 arpents young promising high forest of oak and beech to be preserved for ordinary coupes.		cover is very incomplete and interrupted here and there, by small glades. Holly covers the soil in certain places. Old gnarled hornbeam here and there.	875	Fine oak and beech poles 80 years old, nearly all from seed and mixed with hornbeam coppice; the crop is complete and very promising.
		125	Stag-headed oaks, hornbeam and birch; beech here and there on a soil covered by gorse, heather and juniper.	1,700	Fine young complete and promising thicket, chiefly from seed, with some hornbeam coppice shoots.
		600	Blank covered with heather; a few scattered trees and coppice shoots.	175	Blanks and glades.
		1,125	Oak coppice 17 to 27 years old, seedlings fairly numerous and a few patches of planted oak. Standards few and far between.		
			The Canton Du Bouchant, about 220 acres, is completely stocked with natural seedlings, the felling having taken place in a good acorn year. In this Canton there is a Roman fort.		

Those of our readers who have followed the descriptions given above, will readily perceive the immense improvement, which has taken place. It is indeed certain that, the Tronçais forest at present contains a crop, which although a little too young, will afford almost inexhaustible resources for the future. This accumulation of produce is due to the wise foresight of our predecessors. Let us act as they have done, and a day will come when Tronçais will produce, not 18 francs (Rs. 7·2) but 80 francs (Rs. 32) an acre. The calculation is simple enough. Places, not uncommon in Tronçais, could be pointed out worth 16,000 francs (Rs. 6,400) per acre. When the forest becomes thoroughly stocked and the ages properly graded, we ought to fell 125 acres per annum, representing 2 million francs (Rs. 8,00,000) for a forest of 25,000 acres, or 80 francs (Rs. 32) per acre. This is no exaggeration, for, if on the one hand, every acre is neither now, and never will be worth 16,000 *francs, on the other hand*, we have not *included the value* of the thinnings, which produce almost as much as the principal fellings.

How long it will take for such a result to happen we cannot say, perhaps a century. But what a complete success it is, to have transformed the almost blank area, which the description of 1670 reveals, into the magnificent forest, almost without blanks, which appears in that of 1869. It is certain that, the revenue of the forest will continue to increase slowly but surely. For this, only one point is essential; we must follow the lines of the present working plan, modifying it in a few details, if necessary, but never abrogating it. A working plan requires time to show its value. The present one has already lasted 20 years, and has done excellent work in regularising the standing crops. After 60 years, its good results will be still more evident.

M. de Buffévent, the eminent Forester whose descriptions we have perhaps curtailed too much, deserves the honor of having, so to speak, created the Tronçais forest. He laid down the main lines of the working plan, and his successors, *though modifying them to a certain extent, have only followed* in his steps: to make the old wood last as long as possible: to improve the standing crops so that when the old wood has disappeared, they may yield produce, if not equivalent in quality, at any rate in greater quantity: finally, to fill in all the blanks with conifers. As a result, we find at present, 3,000 acres of old high forest, which will last another 60 years: 3,750 acres of young high forest forming blocks of the third period, which in 50 years, will yield wood 150 years old, a little young perhaps, but quite marketable and able to yield fine timber: together with 5,000 acres of conifers, which are becoming re-stocked almost spontaneously with broad-leaved species, especially oak, under the protecting and fertilizing cover of the pines.

These 5,000 acres of conifers are a conquest over the waste, a conquest which has for some time been productive, for many of the plantations are 30 to 40 years old, and in them the thinnings every 7 or 8 years often produce an annual average revenue of 12 francs (Rs. 4·8) per acre.

This simple and productive idea of filling up the blanks by planting has been steadily carried out since it was prescribed by M. de Buffévent. Every year, the insufficiently stocked coupes are completed, by sowing or planting oaks and beech, and the blanks and glades in the thinnings are re-stocked with conifers. In 1887, this operation will extend over 75 acres. It is clear that in 15 years there will not be a blank in the forest.

M. de Buffévent found the forest either covered with mere herbage, or with impenetrable thickets; the boundaries scarcely fixed, a complete absence of roads, the forest guards living in the neighbouring villages, or in some miserable huts not deserving the name of forest houses.

There are now 20 forest houses, one being sufficiently large and comfortable for the officer in charge of the forest, his family and his friends, among whom we include the inspecting officers, and those foresters, only too few alas! who may wish from time to time to visit and admire the wealth of the Tronçais forest. In this forest, where export roads were formerly unknown, where the trees were dying as they stood, for want of purchasers, we now find 20 miles of ordinary forest roads and 24 miles of metalled ones fit for a carriage and pair.

The facility of export gives a value to a mere bundle of heather, to a heap of chips, and allows the hurried visitor in a two days' tour to form a sufficiently good idea of the forest.

More than 78 miles of boundary ditches have been dug, fixing absolutely the boundaries of the forest, and preventing the slightest encroachment: only 5 or 6 miles remain to be done.

We give the following abstract of M. de Buffévent's description, and of the actual state of the forest:—

State of the Forest in 1832.

	Acres.
Fairly well stocked woods, ...	11,250
Woods ruined by grazing, ...	10,000
Blanks, ...	5,000

Actual state of the Forest.

	Acres.
Well stocked woods, ...	22,500
Unpromising "	2,250
Glades or blanks, ...	1,500

A mere glance shows what has been done.

FENCING OF RESERVES IN JEYPORE.

In reply to "A. J. C.'s" remarks in your October Number regarding fencing of reserves in the Jeypore State, I beg in the first place to observe that the few remarks made in my report on the subject were only intended for the use of the local officials, who are of course well aware how such fences are constructed, and it is perhaps needless to say that the paragraph was not intended for circulation.

However, as "A. J. C." seems to be of an enquiring turn of mind, I have much pleasure in replying to his questions as follows:—

1st. The cost of coolie labour at Jeypore varies from 3 annas to 4 annas per day.

2nd. The nature of the country where it is proposed to construct fences is generally flat or slightly undulating.

3rd. The soil of the Jeypore State consists mainly of sand with a certain percentage of clay and lime.

4th. The object of the ditch and embankment is to keep out all kinds of cattle, the country being overrun with them, so that without a fence of some sort, protection of the reserves situated in the plains at all events is next to impossible.

5th. Forest operations in the Jeypore State being in their infancy, little fencing from a forest point of view has yet been done, so that reference was principally made to the fencing of fields, gardens and compounds by the villagers, engineers and residents.

The total length of such fences throughout the State probably amounts to several thousand miles, but this is of course merely a guess.

6th. These kind of fences are fairly effective, otherwise they would not be in such general use in this part of Rajputana.

7th. The climate being a dry one, the cost of repairs is trifling, and probably does not exceed Rs. 25 per mile per annum, but in the case of an exceptionally heavy rainfall, which is rare, these kind of fences are of course liable to be swept away.

The planting of Pani grass (*Saccharum sara*) on the top of the embankments, where it readily takes root, has a wonderful effect in protecting them from the effects of the weather.

E. McA. M.

STUDENTS FROM THE N.-W. PROVINCES AT THE FOREST SCHOOL.

With reference to the statement on page 521 of the November Number of the "Indian Forester," in the review of the N.-W. Provinces and Oudh Forest Report for 1884-85, the writer

states that, he is under the impression that the Forest Circles of the N.-W. Provinces and Oudh have been rather backward in utilizing the Forest School.

This is to a certain extent true, as regards Oudh, but in the Central Circle, during the last few years, 6 men have been appointed as Ranger probationers, and 12, as Forester probationers. Of the former, no one has as yet passed through a complete course at the Forest School, though one will probably obtain the Rangers' certificate, next March. The other five men resigned their appointments, except one, who failed to qualify.

This shows that service in the N.-W. Terai forests is not popular amongst educated natives, who have much pleasanter and better paid posts available in other Departments, or may become vakils.

Of the Forester probationers, two have obtained the Foresters' certificate, and four are still studying at the School in the Vernacular Class.

The School Circle has largely benefitted by the instruction afforded at Dehra, and two probationers have obtained the Ranger's certificate with honors, a distinction hitherto confined to only one or two men in each year. Besides these, another candidate from the Circle has obtained the ordinary Rangers' certificate, and six others the Foresters' certificate, whilst four are still at the School. The reason why the N.-W. Provinces Circles did not, at first, use the School more freely was owing to the want of graded Rangerships, but as liberal establishments have now been sanctioned by the Government of India, this difficulty has disappeared, and at the time referred to by our reviewer, there were 16 men from the province at the Dehra Dun Forest School, out of a total of 67 students from all parts of India.

LISTS OF FOREST OFFICERS.

Now that there is an Imperial Forest School for training Sub-Assistant Conservators and Rangers, it would be very useful, if the half-yearly list of Forest Officers under the Government of India were to include those in Madras and Bombay as well. Men trained together at Dehra could then readily follow the transfers and promotions of their old friends.

At present, the Bombay list is not prepared like that of India and Madras, and entirely omits all mention of Rangers. Neither does it give the charges of the officers concerned, but is a mere monthly gradation list. Surely the book of India and Madras models could be followed in Bombay, and if the three lists were combined and issued to every Forest office in India, it would be thoroughly appreciated.

Eventually the principal Native States, which also get their

Forest Officers trained at Dehra Dún, could send the necessary information to the Inspector General of Forests, and their officers might also be included in the list, which would then be complete for the whole Forest Service of India.

PRESERVATION OF INDIA RUBBER TUBING.

THREE years ago I found myself supplied with more India rubber tubing than I required, and was afraid that the stock would soon deteriorate. To prevent this, I took 16 feet of 1⅛ inch tubing and 16 feet of ⅜-inch tubing and soldered it up air-tight in a tin box. I have now had occasion to open the box, and found that the India rubber tubes are most perfectly preserved. They had a strong rubber scent, and are as elastic as could be.

The colour of this rubber was originally, and is still, slightly reddish, not brown. If the above experiment proves that India rubber is preserved by air-tight soldering, it would be useful to publish the information, as I know that much loss is incurred in this country by the deterioration of exposed India rubber goods, medical apparatus of India rubber, &c.

H. WARTH.

FIRES IN FORESTS.

IN his Report on the forests of the Central Provinces (November 1885 to February 1886) the Inspector General notes that his observations led him to the belief that an occasional fire in a forest after some years of successful protection had a less harmful effect than annual fires. Most people believe that a fire in a forest that has been closed for a few years renders the state of that forest worse than the first. Would it not be a useful thing to invite the opinions of officers on this important point? I think the Inspector General's idea is true for *Pinus longifolia* forest, but then that is such an exceptionally hardy species as regards fire.

Q.

III. Notes, Queries and Extracts.

Forest Management at Simla.—The following is the account of Municipal forest and gardens at Simla for 1884:—

	Receipts. Rs.	Expenditure. Rs.
Forest, ...	6,369*	2,094
Garden, ...	5,455	11,229†
Orchards, ...	...	3,396‡
Planting trees, ...	...	340
Total, ...	11,824	17,059

In the course of the year the Municipality laid out Rs. 29,000 in repairs to drains, roads, and metalling, Rs. 423 in new railings, and Rs. 35,000 in new works, a large portion of which were walls.

From these figures it appears that the Municipality expends annually nearly Rs. 30,000 on its roads and drains, a further sum of Rs. 5,000 on new works, many of which are directly concerned with, and occasioned by, the destruction of the roads by landslips, torrents, and other like causes. At the same time the Municipality is incurring large expenditure on forests and gardens—Rs. 17,000 expenditure against less than Rs. 12,000 receipts.

The question which suggests itself is (1), whether a portion of this expenditure on roads and works might not be saved by a more effective application of the funds now spent on forests and gardens; and (2), whether these forests and gardens might not, under proper management, become a source of profit.

The process by which the hill-sides in Simla and its neighbourhood are gradually destroyed is, unfortunately, only too familiar to all who know the place. I do not refer now to the wholesale destruction of their property and their neighbours which the neighbouring Rajas have been allowed, in their ignorant and short-sighted abuse of their rights, to bring about. They have put an end, for many years to come at any rate, to

* Exclusive of a payment of Rs. 3,000 by the Raja of Dholepore for arrears of sporting dues.

† Of this, Rs. 5,811 were Capital outlay.

‡ Capital outlay.

the magnificent natural resources of the country. A forest in the neighbourhood of a town or railway is a permanent source of profit. The cutting, necessary for the due growth of the trees that are left, will always supply a good margin on the expenses incidental to its preservation; while the recuperative powers of nature, will in a few years fully repair the effects of moderate and judicious fellings. To burn down acres of forest for the sake of the potato crops, which, for a few years, may be grown on the site: to cut down wholesale for the purpose of sale of charcoal manufactory, and then to allow cattle and goats to browse over the site and effectually prevent as they will the restorative effects of nature, is a process as disastrous financially as it is lamentable from the artistic point of view.

Crores of rupees have been thus wasted by the destruction of forest, all along the Siwaliks from Peshawur to the North-Western Provinces; and the destructive process is still in full swing. *Nor is the injury restricted to the site destroyed; the country* below suffers from torrents, sudden floods, destruction of roads, bridges, canal-banks, and viaducts, and in many places, from sand-streams, which descend from the ruined hills above and reduce thousands of acres of fertile soil to the condition of a desert. Only since the last settlement there has occurred, in a single district of the Punjab, owing to this cause, a permanent annual loss of land revenue amounting to Rs. 90,000.

The same causes are at work, on a smaller scale, in Simla itself. Large spaces of the hill-sides are in many instances left bare or stripped of all undergrowth. Cattle and goats may be frequently seen trampling down and eating the young plants, which in a year or two would become good trees and hold the soil together. Then a small torrent begins to form; it grows with every succeeding shower; day by day, through the rains, a portion of the hill-side is cut from its sides and deposited on the road below. Presently destruction on a larger scale begins; there is a considerable slip, perhaps a house ruined; and the damage has to be repaired by a huge retaining wall supplemented, probably, by a wooden trough, by which the drainage is passed on, *only to work increased mischief at some lower point* of the mountain-side.

As a striking instance of this process, I would invite attention to what has been going on, the whole of these rains, round Peterhoff Hill and the road under Observatory Hill to Summer Hill. A huge chasm has been torn in more than one place, and it increases with every fall of rain; and, if the road is to continue practicable, serious outlay will, in another year or two, be necessary in order to carry the road to Summer Hill over the portions of the mountain-side which have been thus destroyed. Many of the ravines on Jacko are becoming year by year more serious, and threaten the safety of the neighbouring slopes. At the top of one of the bare spots, on this hill, from which tons of

soil had just been washed down into the road, I saw, a few weeks ago, goats browsing on what remained of the herbage. Cause and effect were never more clearly in juxtaposition. To turn in another direction, I am informed on excellent authority, that, owing to the neglect to afforest the slopes below the Serai and Slaughter-house, which were once beautifully wooded, the safety of the main bazaar is seriously threatened, and precautionary measures on a large scale are inevitable.

On the other hand, the Municipal woods have evidently been under no intelligent management. Trees are everywhere crowded together in a way which only insures that they shall never be anything but hideous deformities; hundreds of oaks may be seen standing so close that they have no chance of becoming anything but bare poles, while what foliage they have is out of sight, overhead. Splendid young pines are smothered under some wretched jungle stump, when a few blows from the axe would set them free to grow into noble trees. The value of the timber, whose removal is now essential to the well-being of other trees in the Municipal woods, must certainly be very considerable; and the increased growth of the other trees, to which the clearing would conduce, would, ultimately, be another large source of profit to the Municipality, to say nothing of the increased beauty of the forests. As the woods stand now there are many parts where half or two-thirds of the standing trees ought to have been thinned out years ago, in order that they should not ruin their companions, as they are now doing, or have done; and the sooner they are thinned the better will it be for the future forests of Simla. If the Municipality had in its employ an officer acquainted with forestry, such lamentable waste could not occur; and it is a matter of sincere congratulation that the Municipality is now believed to have resolved upon this most important reform.

But the question is not merely of the well-being of the Municipal woods; there is the larger and more serious problem of the fuel-supply of the future. How this has been managed in the past, one has only to go out towards Mushobra, or in fact on any side of Simla, to see for oneself. Whole mountain-sides, covered with magnificent forest trees, have been turned into howling wildernesses, absolutely worthless to their owners, destructive to neighbouring property, hideous to behold and exceeding costly to the Government, which has to keep up means of traffic across them. All this has been the result of barbarous ignorance and waste. No such destruction is necessary. If a sufficient area were conserved, (Mr. Ribbentrop reckons it, I believe, at about 12,500 acres,) Simla might be well and cheaply supplied, without ultimate detriment to the forest or destruction of the soil on which it grows. A good profit might be earned for the Municipality; an immense boon would be conferred on residents; fodder for five times the num-

ber of cattle, who now destroy the hill-sides, would, in a year or two, be forthcoming; the horrible destruction of the mountain-sides would cease, and an example would be set to the surrounding Rajas, by which, when they saw its results, they could hardly fail to profit. Fuel is now thus supplied from the Government forests at Darjeeling, and the system is approved on all hands. The rise in the price of wood and charcoal in Simla, of late years, has been very marked, and must press hardly on the poor. When one sees the wretched little bundles of sticks which the villagers bring in, and for which they get four annas, it is certain that some effectual remedy is essential, if a fuel famine in the future is to be averted. The subject was urged on the attention of the Municipality by Messrs. Hill and D'A. Vincent in 1876, and again by Mr. Hebbert in 1884; it cannot be longer disregarded with impunity.

There are several other matters as to which there is great room for improvement. *First, as to the management of private* grounds, which abut upon the public roads. There are many of these, where cows and goats have been, and still are, allowed completely to destroy the undergrowth,—where large spaces, accordingly, are left without any protection, and where every shower brings down more or less deposit, and enlarges the torrent bed, which will, sooner or later, involve a larger slip.

Section 120 of the Act enables the Committee of a Hill-Station Municipality to make rules for regulating or prohibiting the cutting or destroying of trees or shrubs, or the removal of soil, "when such regulation or prohibition is necessary for the preservation of the soil, the prevention of landslips or the formation of ravines and torrents." Surely, under this Section, it would be possible to make a rule prohibiting the worst of all forms of destruction, that by cattle and goats. At present, there is nothing to prevent anyone, who is foolish enough to do so, from entirely destroying every young tree in his neighbourhood by allowing animals to browse about at will; and when they stray into a neighbour's grounds, there is no remedy except to send them off in charge of one's own servants to the *pound. I have repeatedly seen this season goats browsing on* the young foliage by the road-side on properties, where, naturally, the condition of the soil ensures the descent of a portion of it whenever rain occurs. Of course, till goats and cattle are prevented from browsing, nothing can be done in the way of afforesting. A goat will do in ten minutes more damage than a forester can repair in as many months; and there is no doubt that each of these destructive little animals (whose numbers are justly said to be a good test of the impoverishment of a county) destroys, every day that it is at large, more than its own value. I would suggest that, with a view to the preservation of the soil in Simla, the grazing of goats and cattle be everywhere rigorously prohibited, and a penalty under Section 121 imposed

for any infraction of this rule. A tax should be levied on all goats brought into the station, and no one should be allowed to keep a goat who has not a proper stable in which to secure it.

The Section, however, does not go far enough. There ought to be a power to call upon the owner of property to take measures for the prevention of erosion, and, thus, the occurrence of landslips. In many cases the construction of a small drain or of a wattled bund would effectually prevent the formation of a torrent; and if the ground were properly planted, the vegetation would hold it firmly together. An excellent instance of the case, with which bare ground may be afforested and protected from slips, may be seen on the hill-side to the south of the new Government House, where a considerable area of new soil, only deposited last year and without a shrub or blade of grass upon it, has been in a few weeks rendered perfectly firm and is now covered with vegetation.

Another reform would be to place some more intelligent persons in charge of the banks by the road-side than those now employed. At present Municipal sweepers are sent round periodically to cut down excessive vegetation, and trim the hill-side; they perform their task with long sticks with which they smash down indiscriminately all that rises above the soil. On one occasion I found a Municipal servant busy with a large rake raking down a steep bank below my house. Any process more fatal to the growth of young shrubs and trees and more certain to entail the ultimate destruction of the bank it would be impossible to imagine.

Another way in which much might be done to preserve the banks would be by properly cutting back the rose-bushes and other plants of a like character, and keeping them as much as possible as creepers on the soil. This is now wholly neglected, and all the benefit of the useful function, thus performed by such plants, when properly managed, is lost.

There should also be a rule by which the practice of digging out clay from the sides of the banks would be prohibited. It is now carried on utterly irrespective of every consideration except the convenience of the excavator; and, as it frequently happens that the finest trees stand over beds of clay, these trees get undermined and their eventual ruin is secured. As an instance of what can be done in this line, I would invite attention to the state of the road to Summer Hill close to the Viceregal Guard House. The hill-side has been completely undermined. There should also be a rule by which the Municipality could call upon proprietors to build up places where excavations have been made, or where, from other causes, the bank is overhanging the road and likely to fall.

It would be well too if the officer in charge at Annandale were directed to have a supply of young trees and seeds for the use of such persons as desire to plant their estates. Many per-

sons would be glad to plant a few trees, if the means for doing so were provided. If the Municipal Gardener were desired to rear annually a few thousand deodars, chestnuts or acacias, for distribution to house-owners, a marked effect would soon be brought about.

I venture to make these suggestions in the belief that, if the Commissioners would act upon them, a great deal of money might be saved, a great deal of waste prevented, and the beauty of this beautiful place be greatly enhanced.—*Pioneer.*

FOREST METEOROLOGY.*—*Forest Observatories.*—Some time before Dr. Brandis's retirement from the office of Inspector General of Forests with the Government of India, he consulted me on the establishment of observatories in connection with the forests, with a view to ascertaining the effect of forests, more especially on temperature and rainfall. Observations of this kind have been made somewhat extensively in Europe, and the work of Ebermeyer† on the results of five years' systematic observations, at comparative observatories (within and without the forests) in Bavaria, is a well-known standard treatise on the subject.

As the result of this consultation, the first step taken in the Forest Department was to establish an observatory at the Forest School at Dehra Dun, which should serve as a model for the forest observatories and a training school for observers. Arrangements were made, by Dr. Warth, for recording temperature, the humidity of the air and the rainfall near the ground and also 66 feet above it, and these observations have been carried on regularly, from October 1882 up to the present time.

In July 1884, the first pair of comparative observatories was started at the Forest Nursery, Ajmere; they were less complete in plan than the Dehra model, sheds of similar pattern being erected under the trees of the forest and in the open ground outside the forest; and readings of the maximum, minimum and 10h. and 16h. temperatures were recorded with thermometers therein exposed, the instruments having been previously verified at the Alipore Observatory. In this case, rainfall was recorded only outside the forest.

In August 1885, another pair of observatories, similarly furnished, was established at the Mohwa Bir Forest, Ajmere, and from the beginning of the present year (1886) comparative measurements of rainfall have been made both within and without six forests in the Ajmere-Merwara reserves.

In June 1884, comparative observatories were established in

* Extract from Report of the Meteorological Department of India 1885-86. Reprinted with Mr. Blanford's kind permission.

† Die Physikalischen Einwirkungen des Waldes auf Luft und Boden. Dr. Ernst Ebermeyer. Wiegandt; Hempel und Paery, Berlin, 1873.

the Dún at the Rámgarh forest, and in March 1885, a similar pair in the Rajah of Nahan's forest, by Mr. Fisher, the Director of the Forest School. These are on the same plan as the model observatory at the Dehra Forest School; observations of temperature, humidity and rainfall being recorded both near the level of the ground and also at an elevation of 60 feet above it, on a structure originally designed and constructed by Dr. Warth.

The results of these observations, so far, seem to show slightly but appreciably higher rainfall in the forest than without. Before, however, this can be accepted as a valid generalization, unquestionably a careful enquiry must be made into the possible existence of other circumstances affecting the contents of the rain-gauge, besides that obvious difference of position, the effects of which is the aim and object of the observations to gauge;* but it is certainly noteworthy that the large majority of the comparative observations up to the present time seem to point out in the same direction. They are as follows :—

Comparative measurements of Rainfall within and without forests.

RAMGARH FOREST, DEHRA DUN.

	Rain-gauges on ground.			*Rain-gauges 60 feet abov ground.*		
	I In forest.	O Outside.	Difference. I — O.	I In forest.	O Outside.	Difference. I — O.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
June (16th-30th), 1884, ..	4·07	3·66	0·41	3·88	3·61	0·27
July 1884, ..	26·46	25·64	0·82	26·44	24·72	1·72
August " ..	21·74	21·18	0·56	21·23	19·88	1·35
September " ..	18·78	17·53	1·25	18·01	17·19	0·82
October " ..	0·39	0·28	0·11	0·37	0·26	0·11
November " ..	0	0	0	0	0	0
December " ..	0	0	0	0	0	0
January 1885, ..	4·48	4·20	0·28	4·63	4·56	0·07
February " ..	0·70	0·85	—0·15	0·67	0·77	—0·10
March " ..	0·39	0·48	—0·09	0·36	0·42	—0·06
April " ..	0·55	0·44	0·11	0·50	0·45	0·05
May " ..	5·99	5·35	0·64	5·79	5·06	0·73
June " ..	10·76	10·31	0·45	10·61	9·75	0·86
July " ..	9·90	9·81	0·09	9·88	9·27	0·61
August " ..	44·91	44·64	0·27	44·45	43·56	0·89
September " ..	5·51	6·24	—0·73	5·47	6·06	—0·59
October " ..	0	0	0	0	0	0
November " ..	0	0	0	0	0	0
December " ..	3·49	3·45	0·04	3·52	3·48	0·04
Totals, ..	158·12	154·06	+4·06	155·81	149·04	+6·77

* One precaution that I have recommended to the Director of the Forest School is for the ensuing year to exchange the gauges and measure-glasses used respectively inside and outside the forest.

RAJAH OF NAHAN'S FOREST, DEHRA DUN.

		Rain-gauges on ground.			Rain-gauges 60 feet above ground.		
		I In forest.	O Outside.	Difference, I — O.	I In forest.	O Outside.	Difference. I — O.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
April	1885, ..	0·42	0·06	0·36	0·86	0·82	0·04
May	" ..	*3·99*	*4·69*	*—0·70*	*4·04*	*4·36*	*—0·32*
June	" ..	11·70	10·47	0·23	11·42	10·07	0·35
July	" ..	10·63	9·81	0·82	9·58	9·47	0·11
August	" ..	45·87	47·50	—1·63	45·87	46·99	—1·12
September	" ..	2·46	2·43	0·03	2·41	2·40	0·01
October	" ..	0	0	0	0	0	0
November	" ..	0	0	0	0	0	0
December	" ..	3·54	3·40	0·14	8·45	8·43	0·02
	Totals, ..	*78·61*	*78·36*	*+0·25*	*77·13*	*77·04*	*+0·09*

AJMERE-MERWARA FORESTS.

	Mohwa Bir.			Madar Hill.			Nag Pahar.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886, ..	0·10	0·08	0·02	0·15	0·12	0·03	0·08	0·05	0·03
February " ..	0·04	0·03	0·01	0·02	0·02	0	0	0	0
March " ..	0	0	0	0	0	0	0	0	0
Totals, ..	0·14	0·11	+0·03	0·17	0·14	+0.03	0·08	0·05	+0·03

	Dania.			Rajgarh.			Dilwara Bir.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886, ..	0·30	0·32	—0·02	0·35	0·25	0·10	0·08	0·07	0·01
February " ..	0·05	0·04	0·01	0	0	0	0	0	0
March " ..	0	0	0	0	0	0	0	0	0
Totals, ..	0·35	0·36	—0·01	0·35	0·25	+0·10	0·08	0·07	+0·01

The obvious tendency of these results is to show that the exis-

tence of forest increases the rainfall; and although, at present, the evidence is very far from conclusive, I should be by no means surprised if this tendency is confirmed by further and more rigorously conditioned experience. Even admitting this, it may, however, be contended that the differences shown are but small; appreciable but not important. But this would be a hasty and unwarranted conclusion. The pairs of observatories contrasted are, it must be remembered, in near proximity to each other, in all cases probably less than a mile, in some less than a quarter of a mile apart; and the influence of a forest, if real, does not abruptly end at the boundary of the forest tract, but must extend to a certain distance beyond its borders; while for some distance within those borders, it is weakened by the proximity of the open country. Hence, any difference that may be shown by these pairs of stations in respect of rainfall, in so far as it is dependent on the presence or absence of forests, is probably considerably less in amount than would be shown, were it possible to contrast the rainfall of a large area under forest with that of the same area denuded and brought under cultivation. But it is almost impossible to institute a valid comparison of such areas on the large scale, because we can never be sure that the results are unaffected by conditions other than those which are the especial subject of the test.

If such influence is real, it may be confidently expected that the effects will be much greater in India than in Europe or most extra-tropical countries; such being the rule in the case of those meteorological actions that bear most affinity to that in question. I may cite, as an illustrative instance, the very remarkable diurnal variation of the rainfall shown by the Calcutta registers. In extra-tropical countries, any variation of the rainfall according to the time of day is but small, and to be detected only on the comparison of a very long series of registers. But, in Calcutta, it is so marked as to be a subject of ordinary observation; and the registers of no more than seven years suffice to show that, in the hot season, the rainfall at 7 P.M., the hour of maximum, is more than twenty times as great as at 6 A.M., which is that of minimum rainfall.

The question of the influence of forests on rainfall has lately been made the subject of a very interesting paper by the eminent Russian Meteorologist Mr. A. Woeikoff. In this, he draws largely upon India for evidence in support of his view, which is substantially that which I am myself inclined to regard as probable. In some cases, doubtless, the want of local knowledge has led him to over-estimate the effect of forest, and to treat as comparable, with reference thereto, instances which are largely affected by other conditions, such as exposure to winds from a dry quarter, to the prevalence of swamps, and the influence of hills. Owing to this defect in the selection of evidence, his conclusions have not commanded that general assent, to which they

may perhaps hereafter be entitled. For this, we must look to a critical discussion of the further data which our Indian rainfall records are now yielding, and to more extensive observation under the rigorous conditions of scientific experimental enquiry, which it may be within the power of the Forest Department to carry out. But speaking for myself, I must admit that, as the result of the extended experience and enquiry of late years, I have been more and more impressed with the growing evidence in favour of the view which Mr. Woeikoff advocates, and while I must necessarily admit that crucial and convincing proof is still wanting, the general tendency of the evidence is so decidedly favourable, that I can hardly regard the long-suspected influence of forests on rainfall as a question of equally balanced probabilities.

Mr. Ribbentrop, the Officiating Inspector General of Forests with the Government of India, has lately drawn my attention to a case of an apparent increase of the rainfall in consequence of forest protection, which is certainly striking, although, like other cases of the kind, defective in some particulars as evidence and therefore not decisive. In preparing the data for the chart of the average rainfall of India, published in 1883, I had noticed that, the rainfall average of most stations in the Central Provinces was somewhat higher, if derived from the previous 10 or 12 years, than when obtained from longer periods ; but as very little is known of the circumstances under which the registers had been kept, I attached no special meaning to the fact. A few months since, however, Mr. Ribbentrop, starting from the fact that extensive tracts of forest, previously devastated by jungle fires with a view to the nomadic system of cultivation practised by the hill tribes, had been brought under protection in 1875, and that thereby the area of vigorous forest growth had been enormously increased, was led to enquire whether this measure had sensibly affected the rainfall, and applied to my office for such records as might throw light on the subject. Comparing the rainfall of the years subsequent to 1875 with that of the years anterior to that date, he finds that the former, in all or nearly all cases, largely exceeds the latter, and he attributes this increase to the preservation of the forests.

The region which must be chiefly affected, supposing that forest protection has really had the influence attributed to it, would be the Satpura, the hilly tract that runs across the Central Provinces between the Nerbudda and the plain of Nagpur and Raipur. For this region, we have complete rainfall registers extending from 1865 or 1867 up to the present time, at the stations enumerated in the following table. I have taken the average of the annual rainfall from the 9 to 11 years ending with 1875, and also that of the subsequent 10 years. The comparison of the two is shown in the following table :—

	Forests unprotected.		Forests protected.		
	Period.	Average rainfall	Period.	Average rainfall.	Increase of annual average.
		Inches.		Inches.	
Badnur, ...	1867–1875	39·83	1876–1885	47·88	+8·00
Chhindwara, ..	1865–1875	41·43	1876–1885	48·48	+7·05
Seoni, ...	1865–1875	52·07	1876–1885	54·76	+2·69
Mandla, ...	1867–1875	53·58	1876–1885	56·32	+2·74
Burha, ...	1867–1875	64·51	1876–1885	71·65	+7·14
Bilaspur, ...	1865–1875	41·85	1876–1885	54·81	+12·96
Raipur, ...	1866–1875	51·59	1876–1885	54·41	+2·82
Average, ..		49·27		55·47	+6·20

The rainfall registers of Jubbulpore at the northern foot of the Satpuras, and that of Nagpur on the south, the one extending over 40 years, the other over 37 years, show that the average rainfall of a station, if derived from a period of 10 years only, has a probable error of 5 per cent., or of between 2 and 3 inches in the case of the stations enumerated. Further, it appears from a tabular summary of the rainfall of India since 1864, that the annual average of the whole country, for the 10 years, 1876-1885, was 0·66 inch greater than that for the 11 years, 1865-1875. About half the average difference shown in the above table of the Satpura stations must then be deducted, before we are justified in regarding the increase as even probably the result of some cause locally operating. The residue may fairly be regarded as indicating some such cause, but having regard to our ignorance of the circumstances under which most of the rainfall registers have been kept, it could hardly be confidently asserted that that cause is the conservation of the forests, and no other. Nevertheless, the facts, if not logically convincing, at least may be regarded as an addition of some importance to the accumulating evidence bearing on the subject.

THE RE-AFFORESTING OF IRELAND.—With reference to the re-afforesting of the waste lands along the western coast of this country, where poverty is continuous, authorities have from time to time declared that the climate of the whole island suffers from the damp and desolated heaths of Connaught and Donegal, that in those districts poverty exists, that from the presence in the country of supplies of timber many industries would spring, and that forests (unlike some other State works) cannot possibly end the loss of the public funds. It is understood that forestry would be among the first works that an Irish Parliament would undertake, but it should not be forgotten that the cost of plant-

ing the four million acres of waste lands here suitable for timber must be enormous, and that even at £3 10*s*. an acre over £14,000,000 would be required. If the waste lands are not to remain waste, it is evident that every acre planted now may be taken as money saved to an Irish treasury. There is no prospect that, under Home Rule, planting will be undertaken as a private investment any more than it is at present. Forestry differs from other investments in the years that must necessarily elapse between the planting of the trees and the payment of a dividend. At the end of fifteen years 5 per cent. will be generally made from timber; in twenty years, 10 per cent.; while in thirty years, and onwards, an annual income equal to the whole original outlay may be generally looked upon as certain. But the distant prospect of a dividend, however great, has but comparatively little attraction for the investing public, and it is this first and unproductive period that is retaining so much land in its state of waste and treeless swamp.

Dr. Lyons, in the bill which he introduced in 1884, suggested that "forest loans" should have a period of twenty years, of postponed interest, after which both principal and interest should be repaid together. A considerable move could be made if two-thirds, or even one-half, of the required capital were allowed to stand until the timber began to pay, and in this direction the Legislature might make a liberal advance. The old system of baronial guarantees, as well as of forests, has altogether broken down. Baronies, where poverty and waste lands abound, are not in a position to give any guarantees, and with them, as with private investors, the unproductive period has proved an insuperable obstacle. But the great measure of re-afforesting this country must be made by the Government themselves. Let them form a forest department, as has been already done in India, and in many European States; let them become owners of large tracts at present waste, and undertake the work themselves. At the end of the non-productive period the new forests might be sold for many times their original cost. Security for the money would be absolute, the Government would hold the forests, and in ten years they would have their choice of either selling their property or of continuing the work, as is being done by the Government of other lands. It is submitted that £500,000 would be sufficient to make a great and successful experiment, and that whenever two million acres are planted in Western Ireland the thousands of idle hands would be employed in districts where at present emigration appears to be the only hope for many.—*Timber Trades Journal.*

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THE FOREST OF THE OUTER NORTH-WEST HIMALAYA;* by D. BRANDIS, C.I.E.

THE Himalaya forms the northern boundary of India for a length of 24 degrees of longitude. The numberless rivers and streams (which carry off the water of the melting glaciers from the higher mountains, the monsoon rains of the summer, the winter rains of the outer mountains, and the winter snow of the higher chains) unite in three great streams, of which two, the Ganges and the Brahmaputra, flow into the Bay of Bengal, whilst the Indus flows into the Indian Ocean. Simla lies on the water-parting between the Indus and the Ganges, whilst Darjeeling, the eastern large hill station for Europeans in the Himalaya, is situated on the water-parting between the Ganges and the Brahmaputra. The western half of this mountainous region takes a north-westerly direction. The North-Western Himalaya is distinguished from the Eastern Himalaya. Simla lies in the north-western, and Darjeeling in the eastern portion.

The forest vegetation of the Eastern Himalaya is nearly related to that of Eastern Asia, Indo-China, China and Japan, whilst in the North-West Himalaya, the forests of the temperate zone at a height of 6,600 feet and above (in spite of some resemblances to those of Japan and China) belong essentially to the flora of Western Asia, and have a great resemblance to the forests of Europe. The vegetation of the high mountains in the neighbourhood of Darjeeling, and that in the neighbourhood of Simla, have only a small number of species in common; they have an entirely different character, which is striking even to the unprofessional eye.

There is, however, no clearly marked boundary between the

* Translated from the German.

vegetation of the Eastern and Western Himalaya, the transition being very gradual. As Sir Joseph Hooker showed in his masterly introduction to the Flora Indica of Hooker and Thomson as early as 1855, Nepál is the region where the transition of the floras of the Eastern and Western Himalaya takes place. A few facts to prove this may here be mentioned. *Quercus serrata*, Thunb., on which the Yamamái silkworm is fed in Japan, and one of the few Indian oaks which are not evergreen, reaches its western limit in Nepál, and this is the case with many trees of the families of the *Magnoliaceæ* and *Laurineæ*, to which the high mountain forests of Sikkim owe in part their great variety. On the other hand, *Rosa moschata*, the climbing rose of the Western Himalaya, find their eastern limit in Nepál.

Here we will confine ourselves to the part of the Himalaya which lies west of Nepál, the eastern boundary of which is formed by the Sárda or Káli, a large tributary of the Ganges. In this part of the mountains lie Kashmir, Basáhir, Tihri and other States governed by Native Princes, while some of the mountain districts of the Punjáb, as well as Jaunsár, Garhwál and Kumáon, are under the British Government.

In the North-West Himalaya, the snow line lies at 16,000 feet, but, on account of the dry climate, it is higher on the northern side, which slopes towards Tibet. As a rule, the forest reaches its upper limit at 12,000 feet. To gain a clear idea, it is advisable to divide the forest vegetation of the outer chains of the North-West Himalaya into three great zones of altitude, the forests at the foot of the mountains, and in the deep valleys to a height of 3,000 feet; the middle zone up to 7,000 feet, and the upper or high mountain zone, up to the limit of forest growth. These three zones of altitude, which are here proposed by way of experiment, must not be regarded as sharply defined regions of vegetation, the intention being only to bring the fact more clearly before the mind, that up to a certain height, varying according to circumstances, the families, genera and species of tropical India predominate among the trees, while higher up many forms occur which remind one of Europe, and at a still higher elevation, these make room for a vegetation nearly related to the forests of Europe. The lower zone may be termed the tropical, the middle, the sub-tropical, and the upper, the temperate zone.* Still, here we are considering regions which lie outside the tropics, and although at the foot of the North-West Himalaya many species are found which are natives of the tropics, yet the low temperature of the winter months is not without its influence on the vegetation, even in sheltered locali-

* These zones might be styled, as follows:—
Up to 3,000 feet, sub-tropical.
3,000 to 7,000 feet, warm-temperate, corresponding to Southern Europe.
7,000 to 12,000 feet, cold-temperate, corresponding to Central and Northern Europe.—[ED.]

ties, and it cannot be said that the climate at the foot of the North-Western Himalaya is of a tropical character. The relation of the high mountain vegetation of the Western Himalaya to that of Europe is described in the before-mentioned introduction to the Flora Indica of Hooker and Thomson.

The three above-mentioned zones of altitude are well marked only in the outer chains, which have a moist climate. The further one penetrates in a north-easterly direction, into the interior of the mountains, the drier becomes the climate, and this has an important influence on the vegetation. The trees have a slower growth, natural regeneration is less vigorous, the forests become sparse and more stunted, and at last vanish altogether, until in Tibet and the neighbouring countries only scrub jungle is found on the banks of the rivers, whilst poplars, willows, and fruit trees flourish only by irrigation. At the same time, trees and shrubs occur which are different to those of the outer Himalaya, and among the herbaceous plants of the drier inner Himalaya, are many species indigenous to Central Asia and Siberia.

The region of transition from the moist climate and rich vegetation of the outer chains of the Himalaya to the bare regions of Tibet offer to the geographical botanist a wealth of instructive facts which are, however, beyond the limits of our present subject. Moreover, a clearly defined limit cannot be drawn, though it may be said that, the outer ranges with relatively moist climate have a breadth of about 100 miles. The foot of the Himalayan mountains at Barmdeo on the Sárda river, lies in the 29th, and above Attock on the Indus, in the 34th degrees of Northern Latitude, and the distance between these two places is nearly 560 miles. With regard to its length, the region of the North-West Himalaya, as the boundaries are here laid down, may be compared with the Alps from the Durance to the Danube, between the 44th and 48th degrees of North Latitude.

The forest vegetation at the foot of the mountains does not in any way remind one of Europe. The sál tree which begins at the Sutlej, the eastern tributary of the Indus, and is the predominant tree in the forests at the foot of the Himalaya as far as Assam, belongs to the family of the *Dipterocarpeæ,* which with 167 species inhabits Eastern Asia, and has its botanical centre in Indo-China and Ceylon. Only three species are known in tropical Africa. The sál is a large tree, with a tall straight bole and large leaves, which change in the spring, although the tree never becomes quite bare. From incisions in the trunk a resinous balsam is obtained, which collects in hollow trees as a hard white resin. The timber is very durable, but hard and heavy, and it splits and warps long after it is seasoned. It can only, therefore, be used for beams and coarse work. Sál begins to bear seed early, and bears plentifully and regularly every

year.* The one-seeded spherical fruit, as large as a hazel-nut, is crowned by the calyx lobes, which develope into long wings; it ripens in the most favorable time of the year, in June, at the beginning of the monsoon rains, after the forest fires of the hot weather are at an end, and the seed germinates as soon as it is ripe. All these are conditions which ensure the young sál tree victory over its companions in the struggle for existence, and the result is that, it always grows gregariously, and forms almost pure forests in which other species only occur as subordinate species. North of the Sutlej, a few small sál forests are found, but further to the north-west, the severe night frosts of the winter put an end to the existence of the sál tree, and at the foot of the mountains, are found forests of *Acacia modesta*, the most beautiful of the Indian acacias, which bears in March and April a mass of fine white flower-spikes among its tender young leaves. In Assam, extensive forests of sál along the base of the Himalayas cease at the river Monás (91° E. Long.), although further up, on the north side of the valley of the Brahmaputra, a few small forests are still to be found, and the tree continues to form dense forests south of the Brahmaputra, for 100 miles further east, but the subordinate species become more numerous, and in the very moist climate of Upper Assam other species successfully compete for supremacy with the sál tree.

At the foot of the North-West Himalaya, there are often valleys which run parallel to the direction of the mountain range, and are mostly cut into the rocks (sandstone and conglomerate) of the tertiary formation. These valleys (dúns) are in part protected against the dry hot west winds of the spring months, and here are found the best sál forests of North-West India. In these valleys and on the surrounding hills, the sál tree ascends to 3,000 feet, and belongs, therefore, only to the lower zone.

The best known of these valleys is the Dehra Dún, which is drained by two small rivers, one of which flows to the north-west into the Jumna, and the other in the opposite direction into the Ganges. A great part of this valley is occupied by tea plantations and sál forests, and on the water-parting, lies the little town of Dehra Dún at the height of 2,232 feet (30° 20′ N. Lat.) The mean temperature in the coldest month (January) is 55°, in the warmest (June) 84°, and of the year 71°. In 1882, the lowest temperature was on the 7th January, 35°, in other years, it often sinks below the freezing point.† In the same year, the highest temperature of the year in the shade was 101·6°. This was on the 25th May. The mean yearly rainfall is 73·15 inches,

* Occasionally, as in 1886, the sál seeds with such profusion, that every small blank in the Siwalik sál forests is densely covered with seedlings, which also form a complete carpet over the soil under the forest.—[ED.]

† Frosts occur on bright nights in Dehra Dún on low grounds and exposed places, till the beginning of April.—[ED.]

and of this, 64·49 inches fell in the four summer months, June to September. These figures will suffice to show the climatic conditions under which the sál tree flourishes. As far as the temperature is concerned, it corresponds to that of Cairo, which lies under nearly the same latitude, but the plentiful rainfall makes a very great difference.

Rawalpindi (33° 4′ N. Lat.) in the Punjáb, lying at the foot of the mountains between the rivers Indus and Jhelum, and, therefore, out of the region of the sál tree, has a higher temperature in the hottest month (June), *viz.*, 89°, but a lower in January, 39°, and in 1882, the minimum was on the 20th December, just below the freezing point. The mean annual temperature is 68°, and the maximum in 1882, was 115° on the 10th June. At the same time, the climate is proportionately dry, with a mean annual rainfall of 33·15 inches. These extremes do not suit the sál, but *Acacia modesta* flourishes in them.

The most important companions of the sál tree belong to families only found in tropical climates, such as *Combretaceæ*, and to others, represented in Europe only by herbs and shrubs, as *Malvaceæ*, *Rubiaceæ* and *Leguminosæ*. Mixed forest composed of species of these and other allied families are found at the foot of the Himalaya, not only beyond the northern boundary of the sál tree, but also within its region, and in addition to these, there occur extensive bamboo forests, which are generally composed of *Dendrocalamus strictus*, a species extending to the north as far as the Biás river, and common throughout the Peninsula and Indo-China, except in the driest parts. If we add to this the dwarf date palm (*Phœnix acaulis*), very common in the forests at the foot of the Himalaya, it is easily understood that the character of the forest flora of this zone in no way reminds one of Europe. In the moist depressions of the eastern Dehra Dún, and still more frequently further east, occur extensive brakes of a climbing palm (*Calamus Rotang*); and several species of *Wallichia*, another species of palm, form thick scrub in the side valleys of the river Sárda, near the eastern boundary of the region.

The forests of sál and other trees occupy the hills and stretches of high land between the rivers, but quite a different kind of forest is found upon the alluvium along the streams issuing from the mountains, and on the innumerable islands formed in these streams, and often washed away after a few years. Sissu (*Dalbergia Sissu*) and cutch (*Acacia Catechu*) are here the most important species. Both are pod-bearing trees, and belong to the *Leguminosæ*, the sissu to the *Papilionaceæ*, but to a genus confined to the tropics; the cutch to the *Mimoseæ*, which are not represented in Europe.

Both *Dalbergia Sissu* and *Acacia Catechu* stand more frost than the sál; they extend westwards to the Indus, and ascend far up into the valleys, the sissu indeed occurring as high as

5,000 feet, while the cutch, like the sál, only reaches 3,000 feet. The *Acacia Catechu* is a widespread tree, it is found through the whole of India, in Burma, Ceylon and in eastern tropical Africa. The sissu on the other hand has a comparatively small area of distribution, it is indigenous only at the foot and in the valleys of the Himalaya. It is not unlikely that the valleys of the Himalaya were its original home, and that the seed was originally carried thence by the rivers into the lower land. Every year the newly-formed islands and other alluvial formations are covered with a thicket of young sissu, sprung from the seed which is carried down by the floods of the summer.

Sissu yields an excellent timber, durable, strong, not too hard, and easily worked. The dark-red, hard, and heavy heartwood of the cutch tree is one of the most durable of the Indian timbers. It is highly prized for oil and sugar mills, and where the tree is common it is used for house posts. The cutch, one of the best tanning materials, is the black extract obtained from the chips of the heartwood boiled down. It is very singular when one steps out of the forests of sál, bamboo, sissu and cutch, in which nothing reminds one of Europe, and sees the neighbouring fields sown with wheat, barley, flax, peas and vetches, and even finds among the crops many of the annual weeds with which we are familiar in Europe. The above-mentioned are the winter crops, which are sown in autumn and harvested in spring, their whole period of growth falling within the cold winter months. The summer crops are completely different. *Sorghum vulgare*, and other large species of millet; *Dolichos*, as well as species of *Phaseolus*, which are not cultivated in Europe; cotton and rice, where the climate is moist enough, or water for irrigation can be obtained. The fields of sugarcane and indigo remind us too that, we are at the foot of the Himalayas, in a climate similar to that of the tropics.

The only one among the many strange trees in this zone reminding us of Europe is *Pinus longifolia*, still only at the upper limit of the lowest zone, and belonging more to the middle zone. Since it often occurs in the immediate vicinity of the sál tree, it may, however, be mentioned here. *Pinus longifolia* is a three-needled pine nearly related to the North American pitch pine and balsam pine (*Pinus rigida* and *Taeda*). Pines are natives of the tropics as well as of temperate climates. The *Pinus Kasya*, which is nearly related to the *Pinus longifolia*, forms extensive forests on the Khasia mountains south of the valley of the Brahmaputra, and in Burma on the mountains between the rivers Sittang and Salween, often with *Cycas* and *Brainea insignis* (which although short in the stem is still a tree-fern) as underwood. Still nearer to the equator, between the 16th and 17th degrees of Northern Latitude, is found another species (*Pinus Merkusii*), which like *Pinus sylvatica*, is two-needled, and forms with *Dipterocarpus tuberculatus*, the In tree

of Burma, extensive forests in the valley of the Thaunggyin river, a large tributary of the Salween.

Pinus longifolia forms the natural transition to the middle zone, in which it rises up to 7,000 feet, and clothes the slopes of the ridges and the sides of the valleys in extensive forests. Its shade is still less dense than that of our pine, and even in canopied forests of *Pinus longifolia*, the ground is covered with undergrowth, or with high grass and a rich flora of herbaceous plants with beautiful flowers.

The following shrubs and trees of the middle zone deserve mention :—*Rubus ellipticus* with yellow fruits, ternate leaves, the leaflets large and nearly circular, the sterile stem thickly covered with long red bristles, resembling a European bramble. It is accompanied by *Berberis Lycium*, a stiff bush with greyish-white bark and small ovate dark-violet berries in short corymbose racemes. *Rosa moschata*, the superb climbing rose of the North-West Himalaya, is nearly related to the common climbing or creeping rose of our woods and forests, *Rosa arvensis* or *repens*, and to the *Rosa sempervirens* of Southern Europe, as its styles coalesce into a column. It covers hedges and high trees in the middle zone, and the dense festoons, bearing a mass of large white flowers, fill the air far and wide with their perfume in May and June. *Rhus Cotinus* is identical with the wig tree, which is widely spread in the south of Europe, and is easily recognized by its round aromatic leaves and the outspread feathery panicle formed by the lengthened sterile pedicels of the inflorescence.

Two other species of this genus also extend over a very widespread area; but while *Rhus Cotinus* belongs to Europe and Western Asia, and finds its eastern limit on the Sárda river, *Rhus semialata* and *succedanea* are trees of Eastern Asia. They are spread over the whole of the Himalaya, and are found in China and Japan. A third species, *Rhus Wallichii*, is very similar to the tree from which in Japan the black lacquer or varnish is made. The fruits of *Rhus vernicifera* as well as those of *succedanea* yield wax, though the extraction of it is unknown to the natives. *Rhus semialata* and *Wallichii* grow between 2,000 and 6,000 feet, while *Rhus succedanea* rises to 8,000 feet.

To the family of the *Cornaceæ* belong two shrubs of the Himalaya, which also occur in China and Japan, *Cornus macrophylla*, Wall., in the Western Himalaya from 3,000 to 8,000 feet, and *Marlea begoniæfolia*, which is found from the Punjáb to Burma between 1,000 and 6,000 feet. Franchet and Savatier have separated the forms which occur in Japan as *Cornus brachypoda*, C. A. Meyer, and *Marlea macrophylla*, Sieb. and Zucc., but C. B. Clarke in Hooker's Flora of British India unites them.

The genus *Rhus* belongs to the family of the *Anacardiaceæ*, which includes several valuable forest trees of tropical India,

as well as the most valuable fruit tree of the country, the mango tree. The mango tree is cultivated throughout the whole of India, and the shade of its dense dark green leaves is, in the hot season, as pleasant and refreshing as its large juicy golden-yellow fruit. In the valleys of the Himalaya, the mango tree is common, but it belongs entirely to the lower zone. If one penetrates into the interior of the Himalaya, one follows, as a rule, the ridges, and forsakes the valleys, because they are so narrow, have too winding a course, and often rise by steep breaks. If a valley is followed, as far as it is practicable, it will be noticed that at a height of about 3,000 feet above the sea, the mango and most of the tropical trees vanish, only a few, especially the cotton tree (*Bombax malabaricum*), with its branches placed in whorls, large scarlet flowers and hard ovate capsules filled with soft wool, extends itself into the middle zone, and is to be found planted in the vicinity of temples, often together with *Ficus religiosa*, up to a height of 4,000 feet. At the bottoms of the valleys extending into the middle zone, quite different trees occur. Fringing the water-courses are seen dense masses of *Albizzia Julibrissin*,* with large flower-heads, fine rosy red stamens, which fully justify the Hindustani name "Golab Resham," the rose of silk. This tree has a wide distribution—it is found in Persia, China and Japan. *Pistacia integerrima* is another tree of the valleys in this zone, nearly related to the two well-known species which occur so often in the evergreen woods of the Mediterranean, *Pistacia Lentiscus* and *Terebinthus*. This tree is important on account of its beautiful heartwood, which is mottled with brown streaks, and is highly prized for fine cabinet work. If we ascend from the valleys to the ridges in the middle zone, we find often on bare stony slopes, only used for pasture, a thorny cactus-like *Euphorbia* with a thick fleshy stem and five-cornered branches generally placed in whorls. Of these cactus-like *Euphorbias* there are in India a considerable number of species. They take the place of the American cactus, and are found most frequently in dry regions on stony hills.

In the neighbourhood of villages up to 4,000 feet, the soap-nut, *Sapindus Mukorossi*, Gærtn. (*S. detergens*, Roxb.) is very often planted; it is a large tree with glossy green pinnate leaves, which form a dense spherical crown. The nuts are used for washing woollen and silk stuffs, and are an important article of trade. This species of *Sapindus* is found in the whole of the Himalaya, in Assam, Sylhet, and also in China and Japan.

Here may be mentioned *Grewia oppositifolia* and *Celtis aus-*

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* With *A. Julibrissin*, and *A. stipulata*, a tree occurring throughout India, and ascending to 4,000 feet in the Himalayas, we find along the water-courses with the sissu and other species *Quercus annulata* and *Alnus nepalensis*, the latter ascending in moist vallies to 9,000 feet.—[ED.]

tralis, two trees which are indigenous in the middle zones of altitude, and are planted near villages and fields, and furnish winter fodder for sheep and goats. The genus *Grewia* is very numerously represented in tropical and sub-tropical India, and some of the Indian species are found in Africa, while others extend eastwards as far as North Australia. *Celtis australis* is found up to 8,500 feet. The identification is not quite settled, but at any rate the *Celtis australis* of the North-West Himalaya is very nearly related to the species known in the region of the Mediterranean, and in Western Asia.

A remarkable tree of the middle zone is *Olea cuspidata*, so nearly related to the wild olive of Western Asia, that many botanists consider it to be the same. This tree grows in the arid climate of Afghanistan, Beluchistan, Sind and the Western Punjab. In the Himalaya it extends as far as the river Jumna, and it is remarkable that near its eastern limit, between the Sutlej and the Jumna, it is only found in dry valleys, which are protected by high ridges from the winds which in summer bring moisture and rain from the south. This is the case in the valley of the Sutlej above Wangtu, in the valley of the Jumna under the protection of the high ridge on which Mussoorie lies, at Piuntra, which is protected from the moist winds by a ridge which branches from the Chor, and in similar places in the valley of the river Tons.

The transition from the middle to the temperate zone is effected by *Quercus incana*, an evergreen oak with grey foliage, which is common in the outer ranges with moist climate between 3,000 and 8,000 feet from the Indus to Nepál. Two smaller trees of the family of the *Ericaceæ* are generally the companions of the grey oak. These are *Pieris* (*Andromeda*) *ovalifolia* with white flowers in drooping clusters, and *Rhododendron arboreum*, which in spring ornaments the forests with its scarlet flowers.* This rhododendron grows in the whole of the outer Himalaya, as a rule up to 8,500 feet, and sometimes, but exceptionally, up to 11,000 feet, and it is found also on the higher mountains of the Indian peninsula. *Pieris ovalifolia* is wanting in the mountains of Southern India, but is found on the Khasia mountains, in Burma, and in Japan. The grey oak forms mixed forests with *Pinus longifolia* as well as with the deodar, and this can be especially well observed at Simla, where the three trees are to be found together. Up to a height of 7,000 feet, the drier and warmer slopes, if they are covered with forest at all, are mostly stocked with *Pinus longifolia*, while the moister valleys, and cooler northern slopes are clothed with forests of oak and deodar. At Simla, between 7,000 and 8,000 feet above the sea, the deodar and oak predominate. On the

* Dr. Mayr considers *R. arboreum* of Ceylon and Sikkim as distinct from the Borás of the North-West Himalayas.—[Ed.]

ridge between Mushobra and Fágu, which rises considerably above 8,000 feet, is found another belt of forest, in which, especially in cool northern situations, the Himalayan spruce (*Abies* Smithiana*) appears, in some places in mixed forest with another species of oak, *Quercus dilatata*.

The grey oak changes its leaves in spring, but without ever becoming leafless. Some of the old leaves fall, while the young shoots grow. These are at first light lilac, nearly white, then violet, so that in May the forests of this oak pass through a remarkable and very beautiful change of colour, before they attain their grey-green colour.

Besides *Rhododendron* and *Andromeda* many other species are found as subsidiary species of subordinate importance in the forests of *Quercus incana*. Such are several evergreen species of *Euonymus*, as well as *Euonymus Hamiltonianus*, Wall., a deciduous species nearly related to *Euonymus europaeus*. This species is also found in the forests of Japan, while *Euonymus europaeus* has a westerly region of distribution, with its eastern limit at the Caucasus and the Ural mountains.

Ilex dipyrena, Wall., a small tree covered in late autumn with red berries like the holly of Europe, is common in Simla and elsewhere, along streams and in other moist places in the region of the grey oak. *Ilex Aquifolium* extends as far as North-East Persia, while *Ilex dipyrena* is confined to the Himalaya.

Several species of the family of the *Laurineæ* in the region of *Quercus incana* remind one of the vegetation of the eastern Himalaya. *Litsæa zeylanica*, Nees., ascends to 8,000 feet in the North-West Himalaya, and with it are generally found some other species of the same family, of which *Machilus odoratissima*, Nees., is deserving of special mention.† This tree spreads itself over the whole of the Himalaya and is common, probably run wild from old cultivation, in the valley of Assam, where the Muga silkworm is bred upon it in the open.

In Kumáon, close to the eastern boundary of the mountainous region here under consideration, grows the beautiful fan palm, 40 to 50 feet high, *Trachycarpus* (formerly *Chamaerops*) *Martiana*, above the belt of *Pinus longifolia* in the region of the oak, Rhododendron and *Andromeda* between 6,500 and 8,000 feet. In this part of the country the ground is covered with snow, as a rule, from November to March.

The climate of Simla (31·6° N. Lat.) may serve to give an idea of the climate of the region of *Quercus incana* and the deodar.

The meteorological station is 7,020 feet high, the mean temperature of the coldest month (January) is 41°, and of the warmest (June) is 67°, while the mean annual temperature is 55°.

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* *Picea* (?).—[ED.]

† Mr. Gamble doubts whether the Himalayan *Machilus* is identical with the Súm tree of Assam.—[ED.]

The moistest period is from June to September, with 52 inches of rain, while 70 inches fall in the whole year. In the year 1882, the lowest temperature 27° was recorded on two days in February, and the highest 86° on three days in May and one day in June. Snow falls from December to March, and often lies for several weeks. As to the temperature, most places in Europe, where the coldest month shows a similar mean temperature, have a considerably higher temperature in summer and the rainfall is of course quite different.

The most important tree of the North-West Himalaya, the deodar, belongs to the high mountain zone. It is true that small groups of this tree may be found planted in the middle zone, especially in the vicinity of temples, but its real region of distribution is between 6,000 and 10,000 feet, and it is sometimes found up to 12,000 feet. In October, the male catkins are developed, and then the ground in the deodar forests, and in Simla the streets, are covered with the yellow pollen. In the following autumn, the thick ovate, cylindrical cones ripen and stand erect on the flat out-spread branches. The scales of the cones fall with the seed, and the pointed woody axis of the cone remains erect.

The following remarks will be better understood if I here at once observe, that among the most important conifers of the North-West Himalaya, the silver fir (*Abies Webbiana*)* is the most shade-enduring, whilst *Pinus longifolia* needs the most light. As far as it has been ascertained up to date, they stand in the following order as regards their relations to light and shade—1*st*, *Abies Webbiana; 2nd, Abies Smithiana; 3rd, Cedrus Deodara; 4th, Pinus excelsa; 5th, Pinus longifolia.*

The durability of its wood makes the deodar the most important tree of the North-West Himalaya, and the Forest Department has, therefore, in these regions given its chief attention to the preservation and extension of the deodar forests. The deodar cedar differs only by unimportant characteristics from the cedar of Lebanon and that of the Atlas, and it is a very remarkable fact, that this tree (certainly in three forms or varieties) has three separate regions of distribution, the eastern on the mountains of Afghanistan, and the North-West Himalaya from the 66th to 80th degree of Longitude East of Greenwich, the middle on the Antitaurus, Taurus, Lebanon, and the mountains of Cyprus, and the western on the Atlas mountains.

Another very widespread conifer of the North-West Himalaya (*Pinus excelsa*), a five-needled species nearly related to the Wey-

* There can be no doubt, as Dr. Mayr maintains, that *Abies Webbiana* only exists in the North-West Himalaya just below the line of perpetual snow, and that the common silver fir is *A. Pindrau*. Dr. Mayr, who has thoroughly studied the conifers of Europe, America and Japan as they grow in their native forests, also considers that *Abies Smithiana* should be *Picea S.*—[ED.]

mouth pine (*Pinus Strobus*), has also two regions of distribution separated by a wide interval. The eastern region of distribution stretches from Afghanistan along the whole chain of the Himalaya to Bhutan, therefore from about the 65th to the 96th degree of Longitude, while the same species was found by Grisebach on the mountains of Macedonia, and first described by him as *Pinus Peuce*. It was also discovered afterwards on the mountains of Montenegro. By means of several complete specimens Hooker established the identity of *Pinus Peuce* and *Pinus excelsa*, and it was recognized by Grisebach in his reports on the progress of the geography of plants.* Hooker has rightly said of *Pinus Peuce* and *excelsa*, that to the origin of these species are attached the most remarkable botanical problems. The family of the conifers numbers still other species, which have a very extensive region of distribution separated by wide intervals. I will only mention *Pinus Cembra* which grows in the Alps and Carpathians, and then is first found again in the north of Russia, from whence it stretches over the Ural mountains as far as Eastern Siberia. The yew (*Taxus baccata*) is indigenous to most forest regions of Europe, but has now disappeared from many places. It is found also in the Caucasus, through the whole of the Himalaya, on the Khasia mountains, in Manchurea and on the Amur. The Japanese *Taxus* is by many people, probably incorrectly, considered to be another species and named *Taxus cuspidata*. *Juniperus communis*, the common juniper, is found in every country of Europe, on the Caucasus, in the drier regions of the North-West Himalaya, in Siberia, as far as Kamtschatka, in Manchurea, on the Amur and in Arctic North America. It is not intended here to enter upon the history of the development of the conifers, but only to point out, that the conifers of the Himalaya are of special importance in the study of the geography of plants.

Pinus excelsa flourishes best in the upper half of the high mountain forest region, often above 10,000 feet, here I have often found dense forests, with an average height of 160 to 170 feet. I mention this, because that excellent observer (who died too soon) Dr. W. Hoffmeister, who in 1845 made an interesting journey through the North-West Himalaya with Prince Waldemar of Prussia, contested the right of *Pinus excelsa* to bear its name, and gave its height as at most 40 to 50 feet. It is true that the deodar attains a much greater size, for I have measured a tree 250 feet high, and deodars growing in the open attain a girth of more than 40 feet. *Pinus excelsa* needs no protection in its youth, and as it bears seed plentifully and at an early age, and the seed is easily carried away by the wind, it reproduces itself in great numbers on bare slopes, especially where sheep and goats are not too numerous. In the high mountains of the

* Can this be conclusively settled from mere herbarium specimens unless Sir J. Hooker had seen both pines growing in the forests?—[Ed.]

Himalaya descending strips of *Pinus excelsa* in the midst of other forest mark the course of old avalanches, and down to 5,000 feet are found large areas of land, which were formerly bare, now covered with secondary forest, composed mostly of this pine. In this way the fact is explained, that in the middle zone, the blue pine is often found hung with the festoons of the white climbing rose. Such a capability of spreading is not granted to the deodar. The tree begins to bear seed after it has attained a considerable age, the seed years occur seldom; the seed is heavy, does not fly far from the tree, and the young plant needs protection. But where, in not too densely stocked oak forests, or in their vicinity, are found some old deodars, there is soon found young growth; in a few years the vigorous, although tender drooping leading-shoot of the deodar grows through the protecting crown of the oak into the light, and in this manner begins in many cases a gradual conversion of the broad-leaved forest into a mixed forest in which the deodar finally obtains supremacy. The sides of the ridges on which the houses in Simla are built were formerly partly clothed with a forest of *Quercus incana*, only here and there stood old deodars, especially in the vicinity of former Hindu temples, as well as a few young woods of deodar. Since I came to Simla for the first time in 1863, many slopes then stocked with oak, have changed their appearance, and without artificial aid,* the deodar has filled up the blanks between the old oaks.

Neither the deodar nor *Pinus excelsa* or *longifolia* have, with the exception of *Pinus Peuce*,† corresponding forms in Europe. A more home-like scene discloses itself, if one follows the ridge from Simla, from which the water flows eastwards into the Giri, a tributary of the Jumna, and westwards into the Sutlej, one of the five main streams of the Indus. We take our stand on the Hattu, a prominent peak formed of gneiss, 10,500 feet high, which is 24 miles in a straight line distant from Simla, and twice as far from the foot of the Himalaya.

In the spring the ground is covered with a rich flora of coloured anemones, and in moist places is carpeted with delicate primroses, the species different, but the genera the same as those of Europe. An extensive view is obtained. To the north is the deep valley of the Sutlej, 8 miles distant in a straight line, but 8,000 feet lower down, for the bottom of the valley has an elevation of 2,500 feet. The road into the valley runs down the north slope, mostly through forest, and shows the succession of the different zones in the clearest manner. On the other side of the Sutlej valley, 60 to 70 miles northwards, lie Deotiba and the other snowy mountains, from the foot of which the Biás takes its rise, the second main stream of the Indus counting

* Except perhaps protection from fire.—[ED.]
† *Pinus Peuci* (?).

from the east. These mountains are 20,000 to 22,000 feet high. Much nearer, only 30 miles in a straight line in a north-easterly direction, are the snowy mountains on this side of the Sutlej, which only rise to a height of 17,000 feet. To the south-east are the superb masses covered with snow, the Bander-punch and others, from which the Jumna takes its rise, and which are known collectively by the name Jamnotri. Exactly in the opposite direction west of the mountains at the source of the Biás river, are to be seen at a distance of 90 miles, the snow-covered ridges of the Dhaula Dhár, which separates the Kángra valley, through which the Biás flows, from the basin of the next main stream of the Indus, the Rávi. Looking from Hattu snow-clad mountains occupy more than 180° of the horizon, from north-west to south-east, and besides this in spring, until the end of May, the Chor, 28 miles to the south, is covered with snow. This remarkable mountain, 12,000 feet high, and only 34 miles distant from the plains, is an isolated mass of granite gneiss, surrounded by shales and wacke, which in the neighbourhood of Simla occupy the space between the tertiary formation of the outer mountains and the gneiss of the inner ranges.

Let us turn our attention from the distant snowy mountains, to the region of forest of the ranges which lie nearer to us.

The first thing noticeable, is that the northern slopes are clothed with forest, and the southern slopes are mostly bare. As already mentioned, the road from Simla follows the watershed between the Sutlej and the Giri. As far as Fágu this ridge has a direction nearly due east, and then turns to the north, and so it happens, that when one goes from Fágu to the Hattu many bare slopes are seen, while if one looks back from one of the high points only beautiful north slopes clothed with forest are seen. In other places in the North-West Himalaya this can be seen even more plainly. From the Karamba peak, a point 10,000 feet high, on the watershed between the Tons and the Jumna, to the north, mountains up to a height of 8,000 feet appear bare, whilst to the south, wooded northern slopes are seen. The influence of the aspect on the growth of forest is very great in the mountain regions of India. In the valleys of the Pegu Yoma mountains in Burma, (where the most valuable teak forests in British territory are,) especially on the east side towards the Sittang river, the northern slopes are often covered with dense evergreen forest, while the warm southern slopes bear forests of teak and other trees which are leafless in the dry weather.

The panorama from the Hattu also shows, that while up to a height of about 8,000 feet above the sea the southern slopes are often bare, and the northern slopes often covered with forest, the higher peaks are generally clothed with forest on every side. In many cases indeed, bare southern slopes are found far above 8,000 feet. An example, which is noticed by every visitor to

Simla, is the Scháli, a steep limestone mountain 9,420 feet high, the end of a high secondary chain, which branches from the main chain in a westerly direction 6 miles from Hattu, and from which the water from the south and west flows into a deep side valley of the Sutlej, while the north slopes descend abruptly into the valley of the main stream. On the top of the Scháli the slopes towards the south and south-west are bare, while a magnificent forest composed of Himalayan spruce and silver fir, of deodar and cypress (*Cupressus torulosa*), clothes the north side of the mountain.

From the ridge, which is opposite to the Scháli, and which extends along the south side of the valley, the tops of the trees may be seen peeping over the top of the ridge. The north side of the secondary chain which unites the Scháli with the main chain is clothed with a dense forest of silver fir, whilst the south side bears the remains of fine deodar forest. Here, as elsewhere, the silver fir and spruce are found more on the northern slopes and in moist situations, whilst the deodar in this part of the mountains is more commonly found on the warmer and drier slopes with a southern aspect.

The cypress of the Himalaya does not form such extensive forests as the other conifers, and is generally found on limestone. It is very nearly related to the cypress of the Mediterranean.

The upper part of the Hattu is clothed with forest on all sides, and near the top of the peak is a belt of *Quercus semecarpifolia*, an evergreen oak of slow growth, generally covered with moss, and hung with long pendant grey white lichens, with burred branches, and coriaceous thorny dentate leaves, whose upper side is dark green and glabrous, while the under side is covered with rust coloured tomentum. The acorns ripen in August during the summer rains, they soon fall and germinate rapidly.

Next to this oak, and in part mixed with it, is the Himalayan silver fir (*Abies Webbiana*).* On mountains which rise to the snow line, at the upper limit of forest growth, above the oak and the silver fir is found, as a rule, a belt of birch (*Betula Bhojpattra*, Wall.), often with *Rhododendron campanulatum*, a beautiful species with large flowers. The outer bark of this birch peels off in thin paper-like layers, which are used as writing paper, packing paper and for many other purposes, and it constitutes a not unimportant article of trade.

Below this upper belt, in which the birch, oak and silver fir, and sometimes *Pinus excelsa* are the most important trees, suc-

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* *A. Pindrau* (?) *A. Webbiana* of Sikkim, and accompanying *Betula Bhojpattra* and *R. Campanulatum* in the North-West Himalaya, is nearer to *A. pectinata* of Europe, with much shorter needles and more distinct silver lines than *A. Webbiana*, in which the needles are remarkably long. The general habit of *A. Webbiana* is also quite distinct, with little resemblance to that of the Lombardy poplar.—[ED.]

ceeds a zone in which the Himalayan spruce (*Abies Smithiana*)* predominates, and in which *Pinus excelsa* often forms extensive forests.

The silver fir and the spruce of the Himalaya differ from each other in the same way, as the corresponding forms in Europe. Darker green, stiffer branches, broad blunt needles in a double row, and upright cones characterise the silver fir of the Himalaya, as they do the European species. But in habit, as well as in other respects it is quite different from ours. The crown is narrower, the branches short and burry, and even in the most densely canopied forest, its form is like that of the Lombardy poplar. The Himalayan spruce has pendant cones, pointed leaves, and the last branches droop. These drooping branches are, however, much longer than those of our spruce, so that the trees obtain from them a peculiar character. With these conifers occur two oaks, evergreen like the grey oak of Simla. The one which belongs to the region of the silver fir has already been described. The other is *Quercus dilatata*, a very useful tree, which (as already mentioned) forms beautiful mixed forests with the spruce on the ridge between Mushobra and Mahasu, 6 miles from Simla, on the northern slope of the Hattu, and on many other mountains between 8,000 and 9,000 feet; the wood is very elastic, easily worked, and warps and splits less than that of the other species of oak in the North-West Himalaya, and its leaves are highly prized as fodder for sheep and goats. As auxiliary species of minor importance are found in this region of forest a number of species, which belong to genera with which we are acquainted in Europe. Of these many are not even specifically different. The yew (*Taxus baccata*) has already been mentioned; of it beautiful specimens are often found in the deepest shade of the dense forests of conifers. *Prunus Padus* of the Himalaya is in no way different from the European species, it grows to a large tree, and I have found it as far up as 11,000 feet in company with the walnut, species of maple, the Indian horse-chestnut, an elm (*Ulmus Wallichiana*), and the hazel-nut (*Corylus Colurna*) of the Mediterranean region and of Western Asia. Bird cherry is widely distributed through Europe and the whole of Northern Asia as far as Kamtschatka. The home of the walnut (*Juglans regia*) is perhaps somewhat more restricted. In the Himalaya, it is a true forest tree, and the timber, as well as that of the deodar and *Pinus excelsa* is floated into the plains and there sold for good prices. In the Jaunsár forests between the rivers Tons and Jumna, I have measured trees 100 feet high, with a girth of 17 feet. It is true that here it does not yield such valuable burrs as those imported from the Black Sea and Persia. The nuts of the wild tree have a thick shell and are not edible, but it is culti-

* *Picea Smithiana.*—[ED]

vated throughout the Himalaya, and then yields a splendid nut. The walnut grows wild in the mountains south of the Caspian Sea, but it is doubtful whether it was originally indigenous in Armenia.

The box tree (*Buxus sempervirens*) forms small woods in moist valleys.* It is the same species which is indigenous in Europe and the whole of Northern Asia.

Four species of maple occur in this forest, which are very similar to ours. Nearest to the sycamore is *Acer cæsium* with thick leaves, the underside grey, and fruit with protuberances. *Acer pictum* is strikingly similar to the plane tree, with smooth glossy green leaves, and has diverging wings to its fruit. While *Acer caesium* (the representative of our *Acer Pseudoplatanus*) is confined to the North-West Himalayas, *Acer pictum* is found in the whole of North and Central Asia from the Caucasus to Japan.†

The Indian horse-chestnut (*Æsculus indica*) is very similar to the one cultivated with us. It is often found solitary in moist and shady ravines, but sometimes forms dense forests on the northern slope of the mountains. This tree is easily recognized by its bark, which peels off upwards in long narrow strips.

It would take us too far, if I were to treat of the ash (*Fraxinus floribunda*), elms (*Ulmus Wallichiana* and *parvifolia*), the hazel-nut (here a tree), the poplars (*Populus ciliata*), &c., the hornbeams (*Carpinus viminea* and *faginea*), the alders, the birches and willows of the Himalaya. What has been said, will suffice to show, that in the forest zone of the high mountains, the number of the different species of trees is very great, and that they for the most part belong to European genera. We find this confirmed, if we glance at the shrubs and smaller trees, which grow in this zone as undergrowth in the forest, or occur on the edge of the forest, or often form scrub jungle of considerable extent.‡

We have made the acquaintance of one species of *Berberis* in the zone of *Pinus longifolia*. The genus has numerous species in India, and among them *Berberis vulgaris*, which with us is at home in the plains; in the Himalaya at 8,000 to 12,000 feet, generally in the forests of silver fir, and particularly common on the edge of grazing places, in blanks in the forest, which are purposely caused by the shepherds destroying by fire one tree after another.

The European genus *Rhamnus* is numerously represented in

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* The leaves of the Indian Box are elongated and not round like those of the European species.—[ED.]

† *Acer lævigatum* and *oblongum* have undivided leaves, and the latter is evergreen and descends to 1,800 feet in the Dún.—[ED.]

‡ We must not forget *Cedrela serrata* growing in damp shady vallies up to 8,000 feet.—[ED.]

India, and our two common species *Rhamnus catharticus* and *Frangula* have corresponding forms in two species of the Himalaya. As *Rhamnus catharticus* is recognized by its opposite leaves and branches, and the sometimes hermaphrodite, sometimes monœcious 4-leaved flowers, just so the *Rhamnus dahuricus* of the Himalaya, which in every respect appears so similar that it might be mistaken for it. *Rhamnus Frangula* has its representative in *Rhamnus purpureus*, with alternate leaves, numerous parallel side nerves and pentamerous flowers.

Of the family of the *Caprifoliaceæ*, *Sambucus Ebulus* stretches from Europe to the Western Himalaya, the genera *Lonicera* and *Viburnum* are plentifully represented in our region, and two kinds correspond to European species, *viz.*, *Lonicera quinquelocularis* to *Lonicera xylosteum*, and *Viburnum continifolium* to *Viburnum Lantana*, which stretches from Middle and South Europe to the Caucasus.

It has already been mentioned that the spindle tree *Euonymus europaeus* and the holly, *Ilex Aquifolium*, belong to genera, which are rich in India, and particularly in the Himalaya are rich in species. *Cotoneaster vulgaris*, which has its Northern limit in the Siebengebirge on the Rhine, is found also in Kashmir, and is in the rest of the Himalayas represented by numerous species of the same genus. A rose and a bramble have already been mentioned. Numerous species of *Rosa* and *Rubus* are found in the Western Himalaya, among others the common blackberry (*Rubus fruticosus*), which has its eastern limit on the river Rávi.

The ivy* (*Hedera Helix*) which reaches from Europe, through Northern Asia to Japan, covers rocks and the stems of trees in the Himalaya, as it does in Europe. On the other hand, *Schizandra grandiflora*, a climbing plant belonging to the *Magnoliaceæ*, which in May adorns the scrub of willows, *Euonymus* and *Rhamnus* (especially under the peak of the Hattu, with its large white flowers, brings to memory the magnolias of the Eastern Himalaya, while the white and purple flowers of many species of *Clematis* are suggestive of Europe. In order to some extent to complete the picture of the forest of the temperate zone of the outer Himalaya, the vine (*Vitis himalayana*) must be mentioned, which covers with the festoons of its rich foliage the stems and crowns of the spruce and other trees, up to 9,000 feet, and which in late summer, like the Virginian creeper, turns to a dark red color.

A species of bamboo (*Arundinaria spathiflora*) known throughout North-West India as ringal, forms in the high mountain region dense undergrowth in the woods of *Quercus semecarpifolia*, spruce and silver fir. Like most other bamboos it grows

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* The Indian ivy has yellow berries, and differs slightly in its foliage from the European species; it is found as low down as 1,500 feet in Debra Dún.—[Ed.]

in large clumps, which consist of many culms growing close together. As undergrowth it only attains a height of 6 to 10 feet, but in some moist valleys, I have seen pure groups, and then it forms a bamboo forest 20 to 27 feet high. The culm, which as a rule is not thicker than a light walking stick, is brought into the plains in great numbers, and used for pipe stems and other purposes. Formerly the ringal was erroneously named *Arundinaria falcata* or *utilis*, this is another species of bamboo, which belongs to the middle zone, and has no importance as an article of trade.

Just as trees and shrubs in the temperate zone of the North-West Himalaya partly remind us of the flora of Eastern Asia, so do the herbaceous plants. We must confine ourselves here to a few remarks on the perennial plants, which are more important for the history of the distribution of plants, than the annual and biennial plants.

Aconitum Lycoctonum and *Actæa spicata* grow in the dense shade of the spruce forest below Hattu, *Aquilegia vulgaris* is an ornament to the sunny slopes round Simla and along the whole road to Hattu. *Caltha palustris* and *Thalictrum minus* are other *Ranunculaceæ* which are common in Europe, and in the Himalayas.

In a similar way other families are represented, among the *Leguminoseæ* many species of *Melilotus* and *Trifolium* are common to both regions, among the *Rosaceæ*, the strawberry and many species of *Potentilla*, numerous species of *Epilobium*, *Artemisia vulgaris* and many other *Compositæ*, many sedges and grasses.

As already mentioned, the road from the top of the Hattu into the valley of the Sutlej passes in succession through forests of *Quercus semecarpifolia*, silver fir, spruce, some deodar and *Pinus excelsa*, and at last through forest of *Quercus incana* with *Rhododendron* and *Andromeda*.

Then follow the fields. Where water is obtainable, it is carried along the slopes often for miles in skilfully arranged canals, on to the rice fields which are carefully terraced. The fields which are not irrigated bear wheat and barley as winter crops, and are cultivated in summer with different kinds of millet, and in the higher situations also with buck-wheat and species of *Amaranthus* and *Chenopodium*.

Through the fields passes a sunny and at times hot road into the valley, which is here nearly 2,500 feet high. The bottom of the Sutlej valley is bare, here and there are extensive areas of terraced and irrigated rice fields, and the land on both sides of the river, as well as the slopes which are not suited to rice cultivation, are mostly used as winter pasture. Sissu is common, and in the villages are found mango trees, ním (*Melia indica*), persian lilac (*Melia Azedarach*), plantains and some large trees of pípal (*Ficus religiosa*), known by its cordate leaves

drawn out to a long point. This tree, as well as most species of the genus *Ficus*, belong to the lower zone, but some species extend into the temperate zone of the Himalaya.

The Sutlej is a rapid stream; about 45 miles up the valley, near the Wangtu bridge, the bed of the river is 5,000 feet high. Here the lower limit of the deodar forest is about 1,000 feet above the bottom of the valley, while 35 miles further up, at the mouth of the river Teedong, where it flows into the Sutlej, the bottom of the valley is 7,500 feet high, and the last of the deodar forest lie immediately on the river.

Above Wangtu, commences the drier climate of the inner Himalaya; *Pinus longifolia*, *Olea cuspidata*, *Albizzia Julibrissin* and some other trees of the moister region are no longer found. *Quercus incana* goes a little further up the valley, on the river Teedong, *Abies Smithiana* finds its limit, still further up extend *Abies Webbiana*, the deodar and *Pinus excelsa*, the last named species extends furthest. On the other hand above Wangtu, begins the pine with edible seeds, *Pinus Gerardiana* and *Quercus Ilex*, the evergreen oak of the Mediterranean and of Western Asia. In their company are found other species, which demand a dry climate, and which are wanting in the forests of the outer range, *Juniperus communis*, and the tree-like juniper of the North-West Himalaya, *Juniperus excelsa*, the white poplar, *Populus alba*, and of smaller shrubs, species of *Carragana* and *Astragalus*, which bring to mind the flora of Siberia. If the Sutlej is followed up still further, the trees become scarcer and smaller, and gradually the transition follows to the treeless regions of Tibet.

A RHYMING REPORT OF THE CONFERENCE SET,
AT DEHRA DUN SCHOOL, WHERE SOME OF US MET,
OUR COURSE FOR THE FUTURE TO LAY AND TO FIX,
IN THE MONTH OF OCTOBER, EIGHTEEN EIGHTY-SIX.

Ho! Mr. Director, and pray how are you?
Broun, Hearle and Fernandez and A. Smythies too;
We're come to examine, according to rule
Your famed institution, the Dehra Dún School.
Please trot out your scholars, one, two, three and four,
We would like just to test them, to see how the store
Of learning you pour on them sticks to their brains;
We are sure that none of you spares any pains—
But, now, what we want is to see and to spy hence
Whether practical teaching, or theory and science
Take the lead in your work, and instead of the art
Sylvicultural, chemistry taught by your Warth?
Waldteufels—what's that?—as explained by Fernandez,

The pip among beetles, on which Clifford grand is,
Law, botany with its long terms to remember,
Form the staple of work from July to November.
On Surveying, soils, with a road or two thrown in,
Like that to Rámgarh, Campbell-Walker crossed moanin',
And on practical Forestry we all rely,
As the cream of the course, from November to July.
The lads are well dressed, like field marshals they shine,
For badges and buttons and braid all combine
To make a grand show that's uncommonly fine;
Especially when —'t is a teak tree in leaf!—
Madras blazes forth with her great golden sheaf;
And gently we'd hint—to your ears our lips close—
Take heed lest the students' *mores* be *feros*.
Next, turn we to think how our forests to guard
From a pitiless foe, how best to retard
His march o'er the land in one great conflagration,
We say that there's nothing like organization,
And measures adapted his murmurs to quiet,
And win to our side, through his interests, the ryot.

Working Plans should be drawn for the good of the forest,
To meet all its wants and its ills, where they 're sorest;
Still rights of long usage, we all must admit,
Have their place:—we our plans, or our purses, must fit
Such troubles to minimize;—doing our best
To make the Plans square with our Rulers' behest.
How to hit off the classes of trees and their number,
How to cut out the bad ones our acres that cumber,
Sample areas, we think, we may use in a rare way
When forests are constant; but linear survey,
When carried o'er hills, through ravines and through vallies,
Will best meet of critics the questions and sallies,
Provided our lines are straight, even and broad
And from end to end of the woodlands are bored.
When a canopy's formed and the trees are well raised,
We all are agreed that the land may be grazed;
On grazing called *light*, as urged by Berár,
We look with suspicion and think it may mar
The hopes for the future of trees that are growing;
Unless, as explained, it is coupled with sowing,
And from fellings, still recent, the cattle excluded,
Till foresters think them sufficiently wooded.

We say that the officers of the P. W.:
Who think 't is enough to say "we will trouble you
To give us wood seasoned, whenever we ask it,"
Should remember, the wisdom of gods it would task it
To grow seasoned trees, all fit for their sleepers;

Their beams and their rafters, their mouldings and reapers,
Or ever they're felled ; so, please, Engineers
Just give us some notice, some two or three years.
And the Forester Indian may serve as the medium
For advertising, without fear of tedium.
In settling our forests, the absolute fact
Of the legal position, alone should attract
The Enquirer's attention, whilst administration
Should not form a part of his notification.

We say that Divisional officers should work
In closest accord with the District head Turk ;*
While financing, and forestry, and discipline too,
Should be left in the hands of Conservators, who
Should be brought into touch with the Governors they serve,
As the muscle and bone with the sentient nerve,
And not be compelled to go up the long avenue
Of Commissioners Financial, or Boards yclept Revenue.

We sifted the list of the terms scientific,
Proposed by Professors, whose craniums prolific
Had sent forth a brood, French, English and Dutch,
On which as we gazed, we said "'tis too much,"
So with pitiless pencil we scored out two-thirds,
Of the neat little pamphlet so full of long words.

The Sub of the future we settled should be
In rank, morals, and learning of gentle degree ;
An alumnus of Dehra, well fitted to bear
Among his compeers his competent share.
We think that such Subs from the Treasury store,
Might be paid, when deserving, Rupees twenty score,
And trust that his Lordship, in Council, may see
His way to increasing their small salary.
We think that the School should wide open be thrown
To everyone willing to pay from his own
Resources, and able to pass every test
Demanded on entrance, and as for the rest,
He must trust to his luck employment to find,
For Government can't be expected to bind
Itself to all comers, though diligent conners
Of learning, who manage to carry off honours.
We hope that proved merit will find its reward,
And end in assuring bed, lodging and board.
We are driven to say, though the fact we regret,
That in entrance exams our faith is upset,
So we ask *our* Professors to send out the test
For future exams, and think it is best,

* The poet prays that District officers will consider the exigencies of rhyme.

That heads of departments should see that the men
Sent up to the School, by voice and by pen
Are able to show they are fitted to draw
The fullest advantage from out the deep store,
Provided at Dehra, so ready to fill
Them full of all learning, wit, wisdom and skill.

When our labours were over, we turned to each other,
Smiled sweetly, and said, "Well done! my good brother."
We thanked for presiding our General Inspector,
(To make these lines rhyme, our muse must deflect her straight course, and we trust that the strange collocation of words will be known by this explanation).
We canvassed each other most freely, and still
We part with true feelings of mutual good will;
With the greatest esteem for our hosts of the School,
Who are good fellows all. Then we drew by the rule,
The lines that by custom are known to be set,
For that solemn old ritual, styled *Pomponette*;
Drank a health to old Nancy, whose reign is now gone,
Replaced by the gown of the Cooper's Hill Don:
We've done for the present our best, and we trust
The future will thank us, when we are but dust.

G. J. v S.

G. J. v S.

THE CULTIVATION OF A WOOD FOR TEA BOXES.

I HAVE been travelling for more than two months through the northern part of India in order to study forest vegetation from the point of view of a forester and botanist. This I was enabled to do with the greatest profit through the kind recommendations of Dr. Schlich of Cooper's Hill and Mr. Ribbentrop, Offg. Inspector General. I must say that, I have not seen many forests in Japan or America more beautifully stocked with magnificent and useful trees than the broad leaved forests of Sikkim, or the coniferous forests of the N.-W. Provinces. I cannot remember all those fine forests without thinking most thankfully of the gentlemen who are in the envious position of studying and working them, and who have not spared time and trouble to show me their forests and the results of their hard work. I may be allowed to mention here Mr. Home and Mr. E. G. Chester of Darjeeling, Messrs. Fisher, Smythies and Hearle of the School Circle, to whom I say "good-bye" through this paper, thanking them most sincerely for their unlimited kindness.

On my way through the Terai, and the hill forest of Darjeeling, I have been told that the scarcity of a timber wood fit for tea boxes is getting more and more felt, owing to the waste

of the various timber trees on private ground. It seems to me a suggestion worth considering would be to propose that the Government should try to cultivate on a large scale a wood for the above-mentioned purpose.

To do that in the quickest, cheapest and surest way, I would recommend the Japanese súji (*Cryptomeria*), or as I will name that tree, the *Sequoia japonica* for the hills around Darjeeling, and the *Paulownia imperialis*, or the Japanese kiri, for the plains and lower hills of the N.-W. Provinces and Punjab.

In Japan, the "súji," or Japanese cedar, is largely cultivated all over the whole empire, but the localities where this tree is found growing wild, are but few, scattered over the main island "Honshin," and these places are rarely seen by any European. There is a mountain north-west of the lake Biwa in the centre of Honshin, covered with large súji trees, evidently wild. There is a broad belt of beautiful forests near Akita, about a fortnight's drive from Tokio, beneath the 40th degree of North Latitude, the winter climate of which country is marked by deep snow for four months, and a temperature, which several times in this season falls to 10° below freezing point. There the súji forms a splendid mass of forests, partly to the exclusion of every other tree, partly together with *Quercus crispula, glandulifera, serrata, grossiserrata, Fagus sylvatica, Magnolia hypoleuca, Æsculus turbinata*, and many other trees; but never is the súji found growing together with another conifer, unless one be planted with it. In such places, the súji attains a height of 150 feet and a girth of 6 feet and more. The tree is also said to be a native of China, and from that country the first seed was brought to Darjeeling by Mr. Fortune, who was sent by the Indian Government to bring supplies of the best kind of the Chinese tea plant. In both Japan and China the tree is usually planted around Buddhist temples, where the finest specimens, towering up to a height of 250 feet (Koyasan), may be seen.

A few years ago, some travelling botanists suggested that the súji is no Japanese tree at all, being brought from China by Buddhist monks together with *Gingko biloba, Sciadopitys verticillata, Pinus koraiensis, Cunninghamia sinensis, Podocarpus Nagi, macrophylla* and many others; but a careful examination of the Japanese forests from the 35th degree to the 42nd degree, a trip which will take about six months, will show, that only *Gingko* and *Cunninghamia* can be traced back to China.

The economic value of the súji in Japan is very great; growing there in all situations and soils, in deep damp valleys as well as on high mountain slopes; it is one of the commonest and also one of the most useful of Japanese timber trees.

The sapwood is whitish-yellow, from 2 to 3 inches broad, and is, when beams or boards are wanted, generally not removed from the dark reddish, sometimes black-bluish striped heart-

wood. The wood is very light and soft, and is used for all kinds of carpentry amongst the less comfortably situated people; the slight resinous smell of the fresh wood soon disappears.

Owing to the frequent occurrence of earthquakes and disastrous fires, which often lay waste a town with 3,000 houses in a few hours, the Japanese use quantities of wood in house-building.

For that purpose, the cheapest timber in the shortest time is produced by the súji, which is profusely planted all over the empire, and at the age of scarcely 25 years, the trees are cut down and shipped to the market.

The almost exclusive method of propagation, used in Japan is, from a forester's and botanist's point of view, very interesting and important, all plantations being made by *cuttings*. That is not at all surprising, if we bear in mind that the American "big trees" are *Sequoias* too, and coppice as freely as the Japanese one, if cut in an early age and in healthy condition. I remember even a great number of *Sequoia sempervirens* stumps, more than 700 years old, perfectly covered with young and very rapidly growing shoots. Close by Kioto, the ancient capital of Japan, is a small forest of súji entirely worked as coppice, with a rotation of 20 to 25 years.

For propagation of the súji, the terminal piece of every branch is used, 1½ to 2 feet long. The plantation in the ground must be made immediately before or at the beginning of the rainy season. The Japanese usually put the cuttings 3 to 5 inches deep in the soil, forming a narrow hole of this depth by a wooden stick of about the same thickness as the cuttings; the young plants grow very rapidly after having made plentiful new roots during the rain. This method is preferred to sowing, the young súji seedlings being tender and easily killed by excessive heat or frost. The súji yields a wood that seems to me very well suitable for tea boxes. I am confirmed in this view after having seen tea boxes made of this wood in Darjeeling itself. Such a box was shown to me in the office of Mr. Home, Conservator of Forests for Bengal. Besides that, I am inclined to encourage the plantation of the súji, because this tree apparently grows well in all different kinds of soils and exposures, from the Terai up to the region of the silver fir.

It would be quite easy to grow within a period of from 30 to 50 years wood of the quality and dimensions required for tea boxes, the manipulation of planting this tree being very easy, cheap and sure, if made in the way and at the season above pointed out. In case these lines may induce some experiments, I will add, the young trees must be planted rather close together, scarcely 4 feet apart; for only in a dense growth does the súji soon lose its branches and produce a clean, straight and valuable bole.

The other tree, which I have in mind as timber-yielding tree

for tea boxes is a broad-leaved tree, *Paulownia imperialis*, called "kiri" in Japanese, which produces a wood still lighter and more quickly growing than the súji, but, as Dr. G. King, Director of the Royal Botanical Garden near Calcutta tells me, this tree does not grow well in the wet climate of the Eastern Himalaya, though possibly the north-western plains and hills might suit it.

The wood of *Paulownia* is largely used in Japan, for boxes of every kind, for furniture amongst the better situated classes, and especially for clogs, which are in common use throughout Japan, and which the ladies use varnished and dressed after the newest fashion.

This tree is planted in the villages together with mume (*Prunus Mume*), nanten (*Nandina domestica*), kaki (*Diospyros kaki*), &c., as a shelter for the kitchen garden or in other accessible places. When the seedlings are two years old, they are cut off close to the ground, and the new shoots grow straight up to a height of 10 feet and more, without a branch in a single year.

In favourable conditions (deep soil), the tree easily attains a girth of 3 to 4 feet within 10 years; these dimensions seem to be sufficient for making tea boxes. In Japan, the tree is sawn off every 8 or 10 years, very close to the ground, and the stool is cleanly cut with a sharp knife. The shoots of the following year grow rapidly and attain even larger dimensions than those mentioned.

As far as I can judge from comparison, the drier climate of the N.-W. Provinces and Punjab, with an average rainfall of from 20 to 50 inches per annum, may prove suitable to this useful tree, which can stand even a good deal of frost. It would be a pleasure to me to provide the Forest Department with seeds from Japan, if my suggestions seem worthy of being considered and proved.

HEINRICH MAYR, *Ph.D. et Oec. publ. Dr.*,
Lecturer in Forest Botany at the University of Munich.

FUTURE ORGANIZATION OF THE FOREST DEPARTMENT.

I WAS glad to read the remarks of "G. J. v S." in your issue for December, and the more such matters as organization and the relations between Conservators and Local Governments or Administrations, and District Forest Officers with Collectors and Deputy Commissioners are ventilated, the better.

Next to the important matters of working plans, settlements and grazing, which should always be approached not only from a professional but from a general point of view, and the scienti-

fic and economic aspect of which cannot be too clearly and repeatedly placed before the non-professional public, there is probably no more important matter connected with the welfare of the Department than its organization and the position of its officers with Government and the officers of the Revenue Department.

Nothing struck me more at the recent conference at Dehra Dún than the feeling of confidence in ourselves and the future of the Department, which the growth of professional knowledge, whether acquired at the Continental Forest Schools or by experience in India, had engendered. It was also very pleasing to a veteran Forester to observe that the greatest freedom of discussion never degenerated into license; that matters of general interest, such as the grazing question, were not discussed or regarded *merely* from a forest point of view, but from the wider stand point of general utility and scientific research; and that there was no tendency to find fault with individuals, whether members of Revenue Boards, Financial Commissioners, or Collectors, measures not men being criticized, and every justice done to the honesty of purpose which animated our colleagues and those placed in authority over us. If we persevere on those lines with moderation, and support our arguments by the hard logic of facts and ocular demonstrations of the benefits of forest conservancy and capability of the Department to govern itself, we must win the day in the long run.

I am entirely in accord with "G. J. v S." in his recommendation that in each Presidency or Province *there should be one head* of the Forest Department solely responsible to Government for its management, and either titularly or practically a Secretary to Government for Forests, in the same manner, as the Inspector General of Forests is virtually, Under Secretary for Forests in the Revenue and Agricultural Department.

It seems unnecessary to represent how greatly such an arrangement would facilitate the prompt and business-like despatch of forest questions. The head of the Department would of course be a selected man of ripe experience, he would be dealing with subjects with which he was familiar, and would be careful not to regard, or attempt to dispose of them only from the forest point of view, any tendency to which would be checked by the Local Government, or head of the Province, and he would be able to give the Government the best professional advice at first hand.

Now I believe I am not wrong in asserting that forest question, more than any others, are dealt with by a number of officers of other Departments perfectly ignorant of the subject, and who change very frequently, whilst the Conservator's views can only reach Government after being filtered through a number of amateur or non-professional channels, and are then dealt with by a Junior Under Secretary, to whom Forestry and its aims and

objects are a dead letter. Under the Departmental head, who might be styled, like the head of the P. W. Department, "Chief Conservator and Secretary (or Under Secretary) to Government for Forests" would come inspecting and controlling officers akin to Superintending Engineers, Deputy Inspectors General of Police, &c. Those inspecting officers, with the Chief Conservator, would form a Board for checking and revising working plans, an important matter, which should not be left to any one officer to deal with however competent he may be.

District Forest officers should be responsible to their own officers only so far as the management of the reserved forests is concerned, and in all matters connected with the discipline, interior economy and finances of the Department, but they may with advantage assist and advise the Collector or Deputy Commissioner with regard to the management of the unreserved forests, in respect of which they might be under his orders.

Such is a brief outline of what I would propose. I fear it will at first appear presumptuous to some of our amateur friends to suppose that a Forest officer could be an efficient Secretary to Government. I remember the same being urged with regard to the P. W. Department, who now have virtually a Chief Secretary, and Joint Secretaries for Irrigation and Railways of their own. Salt, Abkarri, Police, Jails, Registration, &c., have all Commissioners or Inspectors-General, who are really heads of their Departments, and left to administer them more or less as they deem fit subject only to Government. It seems only "Forests," which probably requires greater special knowledge, training and experience than any other Department, except Public Works, which must be dry nursed, controlled and criticized by a series of non-professional and, I regret to say, frequently ignorant and antagonistic officers of another branch of the service.

I am also in accord with your contributor that the pay and position of the Inspector-General of Forests with the Government of India should be improved. He should have the pay and position of other Secretaries, and no Chief Conservator should draw less pay than that of a Collector or Deputy Commissioner, that will I hope and believe all come right in due course, but probably not in "G. J. v S'" time or mine.

I am not altogether with "G. J. v S." in his remarks regarding the young trained officers from Nancy. I feel sure he does not mean to condemn or disparage them, but it strikes me, and will I fear strike them, as rather like "damning with faint praise."

The late Governor of Madras has made certain unfavorable remarks in his final minute, which the trained officers in that Presidency feel very deeply. It is suggested that their education is not good enough, and that they are wanting in enthusiasm. I can only say that so far as my experience goes, and it is pretty extensive and varied, I find the trained officers

as a rule all that can be desired, well educated gentlemen, sportsmen, and full of enthusiasm in their profession and everything connected with it. That is my verdict, and I am not a trained officer in the accepted sense of the word.

Of course it takes some time for a young fellow to gain experience to settle down to work and make himself acquainted with the vegetation and very difficult conditions of Indian Forests and Forestry. Ask any old Civilian of what use is a newly fledged Assistant in either Magisterial or Revenue matters for the first year, *aye, or even two or three years in some cases,* after his arrival? The answer will certainly, in the majority of cases, be "he is quite useless, I would rather have the help of a Deputy Collector." I cannot say that I believe in the Cooper's Hill training sending us out Foresters, and would personally prefer to see our "young gentlemen" go to Dehra Dún, but I for one will never acquiesce in a word of even apparent disparagement on our *French and German trained Forest* officers, whom I consider a credit to the Department and to the Empire.

VETERAN.

NOTE ON BAMBOOS.

A VERY marked feature of the present year is the manner in which bamboos have multiplied themselves in the Melghát forests of Berár, and in those portions of the plains where they have been cultivated. I noticed this first, during the rains, in the months of July and August, in Ellichpur cantonment, where there are some fine clumps of the Katang bamboo planted on both sides of the Mall and in the Public Gardens. In the Mel-

ghát forests the bamboo is the *Dendrocalamus strictus*. It, too, has thrown up fine healthy culms this year, which are stout and overtop their predecessors. It would be interesting to know if the same thing has been noted in the Khandeish forests of Bombay, and in the forests of the southern and western portions of the Central Provinces, where the climatic conditions have probably been similar this year to those of Berár. The new growth varies from one-sixth to one-third in larger clumps, and in some thinner clumps which were worked a year or two ago, the new growth forms one-half of the whole. There was certainly nothing approaching this reproduction in either 1885 or 1884. It is possible that the bamboo has a short cycle, at the close of which it reproduces itself from the rhizomes in far greater quantities than in the constituent years of the cycle.

The proper working of bamboo forest is an important matter in Berár. Practically speaking, there are now no bamboos except in the Melghát. This lack of bamboos elsewhere in Berár is probably due to the want of knowledge, for bamboo has disappeared in the Kinwat forest in South Berár, where some ten years ago there was a fair quantity. In Dr. Brandis's notes on Berár, published in 1878, he speaks of the bamboo in Kinwat, and says that its reproduction may be left to nature. There has since 1878 been no general seeding of the bamboo in Kinwat, but it is now practically extinct there, and will have to be sown. An old journal that I found says, that in 1881 the bamboo cutters left the forest. They had cut away whole clumps. This is the cause of the disappearance of the bamboo. The proper method is to allow no culms under five years of age to be cut, for up to that age their rhizomes are reproducing. But it is beneficial to the clump that a large proportion of the older culms should be cut out, for if left too long, they hamper the growth of the new culms, and deform many of them. I have noticed in old unworked clumps, growing in hedges and in gardens, that the new rhizomes are frequently crowded so greatly that they are forced up into the clump itself, and form a dense mass some 18 to 24 inches above the ground, and from this mass the new culms have risen. The new bamboos, even when they have pierced their way through the dense crowd of older ones, are inferior to what they would have been had they been standing on their own roots in the soil.

In a *Note on Bamboos* of mine, which you printed last October, I referred to the proper way of working them, but I venture to think that our Berár experience may be again commended to the notice of all who have to do with bamboo supply. Except after a general seeding year, when blocks might be closed to prevent the seedlings being trampled on, I think it is a mistake to close bamboo blocks to cutting. The working of individual clumps is what should be attended to. Nor is it enough to say that so many culms must be left per clump. The culms left

must be five years old and under, as they alone reproduce from their rhizomes. If bamboos are to thrive, they *must be protected from fire.*

In the "Indian Forester" for November 1886, at page 520, your reviewer of the North-West Provinces and Oudh Forest Reports for 1884-85, (old enough in all conscience now,) when writing of bamboo cutting says, "we are not told whether cutting close to the ground, a point we consider of much importance, was attended to or not." Without pretending to be certain on this point as yet, I would say that in Berár where, in the Melghát forests, we have much to do with bamboos, we are inclined to think that cutting them too close to the ground tends to check reproduction. This, of course, does not mean that waste is allowed by cutting them too high up, but about 3 feet from the ground appears to be the best for the welfare of the clump.

Gugumal Forests. G. J. van Someren.

GERMINATION OF BABUL SEEDS.

It is, I believe, a common error that goats when fed on babúl pods void the seeds, and thus the seed, having passed through the alembic of the animal's stomach, is better adapted for, and more sure of, germination. In some rules issued by my predecessor in Berár, it is laid down that babúl seed which has passed through goats is to be used when practicable. Where goats are herded at the season when babúl seed is procurable, it is doubtless true that such seed will be found on the ground among the droppings. But I am convinced that the animal has, after eating the pod, ejected the seed some little time later from its mouth, and that the fact of its being found among the droppings is due to the seed being thus quidded out from the mouth and falling where the goats stand. It is due to the capital manuring that the land receives from the manure dropped that babúl groves spring up so well where goats are herded, and not to the seed having passed *through* the goats.

I also doubt whether seeds that have passed through birds are thus rendered more fit for sowing purposes. Birds select ripe fruits, and so the seeds are presumably healthy, and would, in any case, germinate whether they had previously been swallowed or not by the bird. Birds act as distributors only, as far as I can judge. Has it even been proved that the action of the bird's stomach has any beneficial effect on the seed during the short period that it remains inside it?

Berar,
28th December, 1886. G. J. v S.

NOTE ON THE DESTRUCTION OF THE BLACK WEEVIL.*

THE black weevil is an insect well known to grain-dealers, I suppose, the world over, and especially well known in tropical climates. In India it eats the grain of wheat and maize from

* By Mr. F. W. Cabaniss, Assistant Director of Agriculture, Burma,—dated the 5th November, 1886.

the time it is reaped until it is in the hold of the ship, or made into bread and the bread eaten. It will even eat bread after it has been baked. It is most probably found in every rice, til, wheat, maize, and sorghum godown in Burma.

Like many other insects the black weevil seems to flourish particularly well in Burma. This is owing to the even temperature of the climate, as it dislikes the sudden changes to either heat or cold. It is impossible to estimate the amount of damage caused by this insect in Burma; but it is enormous. A large percentage of the shrinkage in stored grain can probably be attributed to destruction by this insect. It is not detected unless in very large numbers, but when the grain is cleaned by being passed through a fan-mill or winnower, grain which has already been thoroughly clean will show a large amount of dust and a material falling off in the weight of the bulk or bin of grain. The Natives try to combat the ravages of this insect by spreading the grain in the sun and then placing gunny cloth on the top of the grain, when the insect, disturbed by the heat of the sun, crawls out of the grain to the top of the cloth and is then shaken off, and the grain returned to the bin. This method of temporarily getting rid of the insect cannot be followed when there is a large amount of grain in store, on account of the expense of handling the grain.

I have been trying for several years a number of experiments with the object of finding a cheap and simple method of preventing the ravages of this weevil. I think that I have found it in the use of naphthaline powder. My method of using the powder is here given for the benefit of the grain-dealers of Burma. It is best to place the naphthaline powder at the bottom of the bin or bulk of grain. To accomplish this take a bamboo about 1½ inches in diameter and long enough to reach from the top to the bottom of the bulk of grain. Punch the joints out of the bamboo so as to be able to pass a stick through from one end of the bamboo to the other. Have the stick made to fit the cavity in the bamboo. Pass the bamboo with the stick in it down through the bulk of grain from the top to the bottom. Withdraw the stick and drop into the top of the bamboo about half a tea-spoon of naphthaline powder. The bamboo can then be drawn out, as the naphthaline is safe at the bottom of the bulk of grain. If the bulks are large, this should be done one to every 10 feet square of the bulk. Repeat the application every 15 or 20 days as the powder evaporates.

The weevil that can leave the grain will do so, and those that cannot leave are killed by the odour of the naphthaline. I do not believe that naphthaline thus used can cause any injury whatever to grain. For seed purposes the germinating powers appear not to be affected in the least. For marketable grain the colour is not affected, and the odour will leave in a short time if fresh naphthaline is not applied to it. The quantity of

powder used is infinitely small in proportion to the quantity of grain, and the powder is entirely destroyed by evaporation, so that for food purposes the effect is *nil*.

Naphthaline powder can be procured at the Medical Halls in Rangoon, at Rs. 2-8 per ounce, and a few ounces of it will be sufficient for one season for any grain-dealer in Burma.

RETIREMENT OF COL. W. PEYTON.

As Colonel W. Peyton, of the Madras Staff Corps, has, under the operation of Section 110, Rule 10 of the Civil Pension Code, relinquished charge of the office of Conservator of Forests, S. C., the Governor in Council desires to record his appreciation of the excellent service rendered by that officer in the Forest Department of this Presidency. Colonel Peyton was in January 1866 appointed Deputy Conservator of Forests, *North Kánara*, and was in October 1870 promoted to the office of Conservator of Forests, S. D., which post, with a slight change in designation and with some extensions of the area under his jurisdiction, he has since held without intermission. During the lengthened period he has served this Government he has displayed a rare devotion to duty and unflagging zeal in the interests of the State, which it is the pleasure of His Excellency in Council now to acknowledge. His management of the valuable forests of Kánara, to which he has given special attention, has been particularly judicious, and he has attained marked success at once in expanding the forest revenue without permanent deterioration of the forests, and in meeting the requirements of the population in the most convenient manner.—By order of H. E. the Right Honorable the Governor in Council.

IV. Notes, Queries and Extracts.

Dr. Aitchison on Plants and Plant Products of Afghanistan.—The third meeting of the session of the Pharmaceutical Society of Great Britain was held on Wednesday evening, the 8th December, 1886, there being a fair audience, including about a score of visitors and several country members, and as it ultimately proved, the programme was exceptionally interesting. Surgeon-Major Aitchison, who accompanied the Afghanistan Delimitation Commission as Naturalist, came to tell the members of his experience in the region of the Hari Rud valley, which lies between the north-west of Afghanistan and the north-east of Persia. It is very seldom that a man of science has the opportunity of exploring that region; very few, if any, have done so before Dr. Aitchison, and he has done it so well—both botanically and zoologically—that few are likely to follow in his footsteps, unless to see with their own eyes the wonders which he speaks about. In his "Notes on some plants and plant products of Afghanistan," Dr. Aitchison settles many moot points which have been attached to the umbelliferous gum-resins since they were introduced into European medicine; he has brought home with him a most excellent collection of herbarium specimens, representing fully 800 species, all of them most complete in every part, and greatly enhanced in their value from the fact that his observations on the spot have added much to our knowledge of the life history of the plants. With the aid of a large map, Dr. Aitchison described the ground he went over, pointing out the regions where the more important plants—asafœtida, ammoniacum, and galbanum—were particularly abundant, and he was very happy occasionally in his by-remarks upon the tendency of the natives to mislead the investigator. For example, he was assured that asafœtida was obtained only from the female plant—"The only one which yields milk, you know." Another native tried to assure him that the plant was not the asafœtida-yielding one by eating slice after slice of the root apparently with great gusto. "You see," said the native, "it is not the asafœtida plant." "Bah!" said another, "you'll now stink like a camel for a month." These are fair examples of the difficulties which the investigator had to meet, but as far as we could judge, Dr. Aitchison took the natives' statements for what they were worth. His description of the growth of the plants mentioned was very graphic, and it created no little astonishment in

the audience when he showed an asafœtida stem about six inches in diameter, and explained that one month he had seen the plain upon which it grew arid and desolate, and in three months it was thick with verdure, the *Dorema ammoniacum* and *Ferula fœtida* having grown to shrub-like size in that short period, and given character to the plain by their foliage and beautiful inflorescence. A month later the barren aspect could be seen again. The mystery as to the origin of galbanum he satisfactorily solved with his specimens of the gum-resin and of the plant itself, and Mr. E. G. Baker's proximate analysis of the gum-resin would appear to establish with certainty that it is the true galbanum. The specimen was exceptionally fine, the tears were distinct pale-coloured, and generally more like ammoniacum, but the existence of umbelliferone in the resin was a conclusive proof of its identity. It is true that the indications of the presence of umbelliferone were somewhat remote, and not so marked as with old specimens; but we yet require some work on this gum, particularly in the direction of ascertaining if umbelliferone is present in recent samples to the same extent as in old ones. In the discussion which followed the botanists had it all to themselves, and it would certainly have been a very dreary affair had not the subjects under discussion long been enveloped in mystery. Mr. Baker, sen., in a very characteristic speech, referred to the value of Dr. Aitchison's work, and gave a very interesting account of the identification that afternoon of the source of royal salep, which Daniel Hanbury in 1856 recognised as different from common salep, derived from orchis species. Hanbury could never get to the bottom of this matter, but now it may be said with certainty that Mr. Baker, in conjunction with Mr. Helmsley, has proved that it is derived from an amaryllidaceous plant, of which he showed a fresh specimen. This was the most interesting point brought out in the discussion; none of the speakers had ever been where Dr. Aitchison made his collection, so that they could not criticise, and therefore the speakers had to be content with the facts as stated, and they warmly expressed their thanks to Dr. Aitchison and their admiration of his work.

The President took the chair a few minutes past 8, and the minutes of last meeting being taken as read, he called upon Dr. Aitchison to read his

Notes on some Plants and Plant-products of Afghanistan.

After Dr. Aitchison had briefly referred to his appointment as Naturalist to the Commission and the work of the body, he described the route by which the company marched to the region where his investigations were chiefly made. That region was situated north and south between Herat and Panjdeh, to the west towards Persia, including the north-east corners of it, and to the east, including the north-west corner of Afghanistan.

His attention was confined to plants which yield products of commercial value, and his work in this direction consisted of collecting botanical specimens as complete as possible, and at various stages of growth, also the ripe seeds for distribution to botanic gardens, such as Kew. He also endeavoured to obtain information as to local names and uses, but his difficulty in many cases was that there was no population from whom he could get that information. Umbelliferous plants are the characteristic type of the vegetation which abounds in the region. This may be on account of the peculiar situation of the plains, which are from 2,000 to 4,000 feet above the sea level. There is no surface water, and none can be got without digging to an enormous depth, yet, strange to say, plants grow on the soil in abundance during few months of the year. He graphically described a plain covered with vegetation, of which the *Ferula fœtida*, *Dorema ammoniacum*, and *Ferula galbaniflua* were the principal individuals. The first two invariably grow together. From the time that the plants begin to grow the plains are one mass of green, then the stems begin to shoot up, and lastly a dreamland aspect is imparted to the scene on the appearance of the beautiful inflorescence. All this lasts from the end of April to the beginning of July, when it disappears as suddenly as it began.

Ferula fœtida.—Dr. Aitchison described this plant as an excellent one in fruit, and referred in detail to its growth. Regarding collection of the gum-resin, he explained that the natives stated that the plant does not yield asafœtida, but he humorously observed they have a faculty for telling travellers things which are very different from what can be seen by careful observation. The collectors come to the plains supplied with sufficient provisions to last them for several weeks. They lay bare the root stock before the flowering stage has been reached, and cut off a portion of the stem, from which a milky juice exudes. Next the root is covered with a dome-like structure of earth and leaves, with an opening towards the north, so that the sun may not hinder the exudation. In five or six weeks they return, and by this time a thick gummy, reddish substance, resembling the asafœtida of commerce, has appeared on the root. This is scraped off and placed in a leather bag. The roots may yield a second supply, but not so abundantly as the first. The asafœtida is then sent to Herat, where it undergoes adulteration to fit it for commerce! Red clay being an important factor in this subsidiary industry. Dr. Aitchison stated that he had found another species of asafœtida-yielding ferula in a different part of the country (Beluchistan), which was distinct from the true *Ferula fœtida*.

Dorema ammoniacum.—This grows along with, and as abundantly as, *Ferula asafœtida*, and in the young state it is scarcely possible to distinguish them, both yielding a juice; but as they grow older, the dorema stem begins to show its characteristic feature—large swellings in the side. It is also recognisable from

the inflorescence, which is different. When at the fruiting stage the plant is attacked by insects, which puncture the stem, from the wounds a juice flows out, which soon concretes. This is ammoniacum. The author had also observed another ammoniacum plant in abundance, *viz.*, *Dorema glabrum.*

Ferula galbaniflua.—The galbanum plant was described minutely, as no previous description of it is wholly correct. After referring to the amplification which is required upon Bentley and Trimen's description of the plant, he stated that it grows very abundantly in the Gulran vicinity. In the young stage the stem has a beautiful semi-opalescent appearance, and as it grows older it is vividly marked with rainbow colours. From an early stage of its growth, it yields by puncture a milky juice which very slowly concretes. This is galbanum. It has a celery odour, and is very adhesive, so that when removed, it generally takes some of the stem with it. This is collected and sent to India, where it is largely used by the people.

The next plant referred to was described as the sumbul plant, which has been identified as *Ferula sauveslus.* It is new to botanists, and we gather that it is the source of the sumbul root of commerce. After reference to some other umbelliferous plants of minor importance, Dr. Aitchison proceeded to describe three new kinds of *manna.* The first is from *Cotoneaster acutifolia*, a tall shrub growing on the hills in thickets. As the plant ripens, the branches become covered with the exudations, which is removed by simply shaking the branches and collecting the manna in a cloth as it falls. A second kind, grown in the vicinity of Rui Khaf, is also new, and the third is obtained from *Tamarix gallica*, not *T. mannifera.* He obtained another specimen from *Salsola fœtida* in fine tear-like masses, but that had been lost.

The next plant of importance which was described was *Glycyrrhiza glabra.* This is largely collected and is converted into black liquorice by the inhabitants of Turkistan. In the preparation whey is used, this imparting to the extract a peculiar piquancy which is not obtainable by water alone. Liquorice is also largely imported into the country from Persia.

Two species of astragalus, which yield a tragacanth-like gum, were then referred to. This is a peculiar form which exudes spontaneously, and Dr. Aitchison found on cutting a stem that the juice proceeded from the medullary space. It is collected and exported to India, where it is used chiefly for stiffening fabrics. A species of rhubarb, known to the natives as "fool's rhubarb," was found near the Barkut mountains. The root of this is used by natives as medicine. Specimens were shown, and it was stated that some seeds of the plant had been sown at Kew, and plants were now growing from them, so that their identification is approaching. Amongst the other plants referred to were *Micarinda spinosa*, the root of which was one of the most

nauseous and intolerable smelling substances which he had ever come across. *Astragalus Heratensi*, the source of anzeroot, or sarcocalla, hitherto undetermined and *Delphinium Zatil*, which yields flowers largely used as a yellow dye stuff in India, the source of which has hitherto been unknown.

After Dr. Aitchison concluded reading his paper, he was heartily applauded, and the President called upon Mr. E. G. Baker to read a note on a sample of Afghanistan *galbanum* collected from *Ferula galbaniflua*.

This being Mr. Baker's first appearance as an original worker, he received a special round of applause. His analysis of the gum-resin brought home by Dr. Aitchison, gave the following results from 5 grammes of the powdered material :—

	Per cent.
Petroleum ether extract, ...	3·108
Ether extract, ...	*61 200*
Alcohol extract, ...	7·576
Water extract, ...	17·028
Insoluble matter, ...	10·560
Ash, ...	2·463
Volatile oil and moisture, ...	5·332

The water soluble matter, chiefly gum, gave a precipitate with ammonium oxalate and lead acetate, but not with borax. The ash was found to contain sodium and calcium as carbonates, and spectroscopic examination gave a faint indication of storontium. The resin gave a dark-brown colour with sulphuric acid, none with hydrochloric acid in the cold, but a dirty red on boiling, without change on the addition of alcohol. The umbelliferone reaction was obtained with ammonia, and sulphur was proved to be absent. On comparing it with museum specimens, he found some points of identity, but there were also points of difference, and on applying Hirschonn's test for Persian galbanum, it did not satisfactorily respond to it, and his remarks appeared to indicate that Hirschonn's test requires revisal.

Dr. Trimen was then called upon by the President. He commenced by referring in warm terms to the service which Dr. Aitchison had rendered to botanical science by his painstaking and laborious investigations. He was especially pleased that Dr. Aitchison had brought home such a complete set of material, and having himself some years ago worked on umbelliferous plants, he knew how much material for the proper illustration of certain members of the order was required. He then referred to points of difference between some of the plants as brought home by Dr. Aitchison, and the description given of the same in "Medicinal Plants," referring more especially to ammoniacum and galbanum. To a question regarding the frontier of Persia and Afghanistan, Dr. Aitchison replied that the same question had been put by the Shah of Persia to one of his ministers.

After some time the reply was "I refer you to the British," remarks regarding the region where the umbelliferous plants grow, Dr. Trimen concluded by again complimenting Dr. Aitchison on his excellent work.

Mr. J. J. Baker (Kew), the next speaker, made a very acceptable speech. He stated that his Afghanistan work was but a small portion of what had been done by Dr. Aitchison for botanical science, and referred to his note book of the flora of the Punjab. This was done twenty years ago. During the last Afghan war he had worked up the flora of that country, and now he had thoroughly investigated the region which connects the three great divisions of Asiatic flora. These were the Indian—extensive and rich flora comprising about 15,000 different species; the Siberian, also an extensive and most characteristic flora; and the Oriental, which was rich, and contained most peculiar species. All these seemed to be concentrated in the spot explored by Aitchison. He gave the audience a graphic account of the extent of Dr. Aitchison's work, which comprised zoology as well as botany, and then made his statement regarding royal salep, which first received attention from Hanbury, thirty years ago, and pointed out then in a paper (reprinted in Science Papers) that the royal salep partook more of the character of a bulb than a tuber. But he could not get at its origin, although he made repeated inquiries. A sample of this royal salep brought home by Aitchison was shown which presented the characteristic nucleus, or clove, peculiar to tubers. He contrasted this with Hanbury's figure, and showed them to be identical. Lindley had thought that the royal salep was obtained from some species of tulip, but Mr. Baker said it was nothing like it, and only that afternoon he, along with Mr. Helmsley, Oliver, and Johnston, had been able to refer it to *Unguernia trisphera*, belonging to the natural order amaryllidaceæ. He showed a fresh specimen of the bulb of this plant, and described it botanically. This discovery removes royal salep entirely from the other saleps, and it would appear that it is more like those which grow in Central Africa, and which are used by the Kaffirs. The subject is still being worked up by Mr. Johnston, at the Kew laboratories. Messrs. Hemsley, Jackson, Bentley, and Holmes also spoke, but their remarks were mainly complimentary to Dr. Aitchison, and nothing new was added to the knowledge which was conveyed in the papers read. The President then formally put a vote of thanks to Dr. Aitchison and Mr. Baker to the meeting, and it was carried with acclamation. —*Chemist and Druggist.*

SOUTH AFRICAN STINK OR SNEEZEWOOD.—The following interesting correspondence respecting this "uneuphoniously named but invaluable" wood has appeared in the *Times*, and, in view

of the proposed manufacture of new rifles, should be fully weighed by the Government Commission now trying to discover the best style of weapon for "Tommy Atkins." If our Colonies can supply a better wood than walnut for gunstocks, and one which is equally cheap, by all means let us have it.

"Sir,—In a most instructive leader of the 11th instant you refer to a Cape wood as 'uneuphoniously named but invaluable.' Doubtless you mean 'stinkwood,' and as it behoves every man to contribute to the welfare of his country by communicating his share of practical knowledge, I respectfully send you this letter, as I believe its publication may lead to important results.

"It may be within the recollection of some of your readers that when, some thirty years ago or so, our officials, with that charming and child-like simplicity which has ever marked our Government in such cases, conducted a certain foreign General over our military store-houses, he exclaimed on seeing the immense piles of walnut musket stocks in the rough, '*Ciel! quelle quantité!*' and went on to ask whence they could possibly be all procured from, when he was answered, 'from France, Monsieur,' the result being an immediate French edict forbidding the export of all such stocks. Now, walnut has for generations been considered the one wood for this purpose. Nevertheless, I set myself soon afterwards to make inquiries, and published a letter in a popular journal referring to one or two Australian woods, and generally inviting specimens of any wood for testing purposes. The only results were a highly complimentary letter from Australia, advising me that the writer had sent me as a present a log of most suitable wood, and that a ship captain had kindly undertaken to deliver it free, as it would lie on deck and not be included in the ship's manifest (a sad blunder, for I should cheerfully have paid the freight, and no doubt it was chopped up by the cook for firewood), and the late Sir Charles Cuyler sending me the stock of a double-barrelled gun, constructed in South Africa of this same stinkwood many years before, which had passed through no end of rough usage. In a long letter his praises of this wood as being suitable for gun stocks were great indeed. Well, the stock reached me duly, and I tried it by every test. I never had seen, nor have yet seen, such an excellent wood for this purpose. Its dull colour and the absence of any of that variety or 'marbling,' sportsmen so much affect were its only drawbacks. Its toughness was beyond belief. On cutting through the fore end with a saw, leaving, say, a quarter of an inch, as workmen do, to be broken off, I found this fraction of the cross-section would not break, although I literally twisted it round and round like a rope, but in vain, finally having to cut it through with a chisel to detach the nearly severed part from the main piece.

"Not to intrude unduly upon your space, permit me only to give, with more than half a century's practical experience, my

opinion that if this can be obtained in sufficient quantities, we possess in our Cape Colony an article of national importance. Walnut is the wood *par excellence* for *gun-stocks, for its comparative* lightness, its want of a reedy fibre, so that it does not readily split, and its cheesiness on being cut into and so admitting the close adjustment of wood and iron. But certainly it cannot be called a tough wood, and all sportsmen know how easily a stock can be broken at the handle. Stinkwood, judging by the stock I had, has all the walnut's good qualities. Now, soldiers in the heat of battle have not unfrequently to club their rifles, and use them as their ancestors handled their maces in the days of old. The consequence is that one well-delivered blow may floor an antagonist, but the stock is certainly fractured at the handle, and the gun rendered useless. I do not believe that any such blow could fracture this unhappily-named but extraordinary wood, and I earnestly recommend it—all the more that supplies of walnut are yearly becoming small by degrees and beautifully less—to the notice of our authorities. To your readers I would only add, this is a matter of much more importance than may at first sight appear.

J. D. DOUGALL,
Bennett Street, St. James's Street."

"Sir,—Would you allow me to correct an error in your report of the conference held subsequent to the trials of colonial timber at the works of Messrs. A. Ransome and Co., Chelsea, on the 8th instant.

"I am reported to have said that the wood from the Cape Colony known as umzumbit resisted the attacks of the teredo, a marine borer, which *mercilessly destroys most sorts of timber.* The umzumbit has been used with great success for bearings for the diamond polishing wheels at the Cape Court of the Colonial and Indian Exhibition, lasting seven times as long as lignum vitæ, but it has never been employed in marine works.

"It is sneezewood (*Pteroxylon utile*) which I mentioned as being of such great value for this species of work, its peculiar smell, from which it derives its name, preventing altogether the attacks of the teredo.

JAMES COOPER, *Cape Forests,*
Marlborough Grange, Cowbridge."

"Sir,—I also can bear witness to the valuable qualities of sneezewood for gun-stocks. Some years ago I was hunting in South Africa, *and found that the walnut wood stocks supplied* from England did not either meet the exigencies of the climate or the rough work demanded from them, as the desiccating air of the Kalihari Desert quickly shrank the wood and caused the ironwork of the locks and other parts of the rifles to stand out from the gun-stocks. The results were, of course, unreliable locks (taking up dust or damp easily) and constant broken

stocks from brittle wood. During a stay at Colesberg I had sneezewood substituted for walnut stocks, and I gave these most severe trials in another hunting trip into the interior. I found sneezewood to be without any of the faults of walnut wood, and if it can be obtained in sufficient quantities, it will, I am sure, quite bear out what Mr. J. D. Dougall has said of its merits for military rifles.

W. F. WEBB."

"Sir,—I am pleased to observe that my recent letter in your columns has drawn attention to the above subject, which is certainly of national importance. Great changes are being made in small arms, and they are not now the rule, strong, and simple 'Brown Besses' with which our forefathers achieved so many victories. For them the bullets (spherical) were purposely made smaller than the bore to facilitate loading, and were only held in their place in the breech of the gun by the paper of the cartridge. This, as a matter of course, reduced the recoil, but at the expense of accuracy, and it is on record that 200 shots have been experimentally fired at a dummy soldier at 40 yards' range without one bullet striking him. Readers of history may also recollect that on the morning of the battle of Waterloo the barrels of the muskets, which, as usual, had been stacked loaded, had taken in so much water from the heavy rains during the night that the cartridge paper and the gunpowder had been reduced to a wet pulp; consequently, the paper having lost its consistence gave no hold to the screw of the ramrod, and the now useless cartridges could not be withdrawn. It is an historical fact that had not an ingenious sergeant hit upon the plan of swinging the muskets rapidly round, muzzle outward, and so discharging the bullet and cartridge by mere centrifugal force, the consequences might have been disastrous. I give this apparent digression to illustrate the difference between the past and the present, when an elongated bullet has to be driven at an immense velocity through a rifled barrel, the grooving of which bears hardly on it all the way. Consequently there is great strain on the weapon, and every repetition of such strain tells on its general solidity. The recoil is also very great, and I believe it has been stated in the columns of the *Times* that the shock of this recoil has even cracked military walnut stocks at the handle. If magazine rifles come into use, as is pretty certain, and in fitting the magazine the amenity of the stock has to be infringed upon, we shall have a still greater necessity for the toughest possible wood, if we wish to put into the hands of our soldiers the very best weapon extant. Confidence in his weapon is of prime consequence to a combatant: the want of it may produce disastrous consequences to even the bravest of men. The former may lead to victory, the latter to defeat, other things being equal.

"It is gratifying to find my former statements fully corroborated by so good an authority as Mr. W. F. Webb, after practical experience in the trying climate of Africa. It may surprise your general readers to be told that guns are peculiarly affected by climatic influences. All desiccating air acts most tryingly on the stocks and thereby loosens all the fittings, as so correctly described by Mr. Webb, and there are other climates which rapidly injure generally all but the very best materials and sound fitting, of these China having about the worst.

"I may be permitted to state in conclusion that I have not recommended this wood from any selfish motives. My vocation is as distinct from that of a military gun contractor as it well can be. But circumstances, to which my more pointedly referring might be deemed egotistic, have caused me for many years to study the vexed question of modern gunnery in all its branches, and I may at least say that I have never been found a misleading guide, but the contrary. I should also wish to add that this nation is entirely dependent upon foreign countries for an adequate supply of walnut, and what might not this lead to during a protracted war! I have endeavoured to show how we can protect ourselves, and if my advice be not taken by the authorities concerned I shall at least have the satisfaction of having done my duty to my fellow-countrymen.

J. D. Dougall."

Felling and Trucking in Forests.—The felling and transport of timber in forests is in many cases still conducted by inefficient and obsolete appliances, notwithstanding the introduction of several inventions specially designed to remove the difficulties, vexations, and expense inseparable from these primitive methods. In forests which are periodically depleted, and a regular and fair supply of timber produced, felling by steam-power and transport by rail trucks effect an immense saving in labour, despatch, and expense over the hand saw, the axe, and haulage by horse-power. This said, we need make no apology for introducing to the notice of our readers a system for accomplishing these preliminary operations in the "forest primeval," recently brought under our notice by Mr. Arthur Koppel, of Tempelhofer Ufer, Berlin, S. W., the inventor and patentee, who is represented in this country by Messrs. R. Uhlich and Müller, 2, Bury Street, St. Mary Axe, London, E. C.

Our illustration, *Fig.* 1, shows Mr. Koppel's method of working the saw by steam. The saw itself is so inconsiderable in weight that it can easily be carried hither and thither. It can also be wheeled with equal ease by being attached to the axle of a small hand cart. A strong screw, the end of which is

fastened in the tree, and which is connected with the apparatus by a bar, suffices to place the saw ready for action. The rapidity with which this saw works is very great, and in a few minutes an oak or any other hard or soft wood tree of the largest dimensions, is felled to the ground.

Even if we include the time necessary to convey the saw from one tree to another, we find that the saw can fell 40 trees of the largest dimensions in a day of 10 hours length. Experience has proved this, although this admirable machine is of very recent date. Already it is in use in many of the largest forests of Hungary, Slavonia, Roumania, and the Caucasus.

A single steam engine suffices to keep four of these saws in operation at the same time in various directions. The reader may notice the different manipulations which can be effected with this saw.

Fig. 2 shows the employment of Mr. Koppel's rail trucks for the transport of long timber. For this purpose two trucks are always used, and in this manner the narrowest curves can be managed even when the timber is of great length. The logs are kept in position on the trucks by strong chains, which, however, allow them full play in turning corners, &c.

Fig. 3 shows a carriage for the conveyance of log ends, butts, and short trees, which is placed on the two trucks employed for the conveyance of long timber. A bolt passes through the centre of each truck and the carriage or upper framework, which facilitates the turning of the trucks independently of the carriage. Rollers are attached to the lower part of the car, which facilitate the motion of the trucks on the same, and afford additional support to the carriage.—*Timber Trades Journal.*

THE forests of East Tennessee are prolific of ivy, and annually yield thousands of dollars' worth of roots, which are shipped north, to be made into door knobs, bureau knobs, fine veneering, inlaid work, &c. The roots, delivered at the railway stations, are bought by dealers at 11 to 12 dollars per ton. The demand is great, and the supply in the mountains appears to be unlimited.

PROFESSOR Poleck has discovered that timber immersed is no longer liable to the attacks of *Merulius lachrymans* or dry rot fungus. The water dissolves out the albumen and salts, and thus deprives the fungus of the nutriment, needful for its development.—*Transactions of the Institution of Civil Engineers* (Vol. lxxxvi., p. 9).

FELLING AND TRUCKING IN FORESTS.

Fig. 1.

Fig. 2.

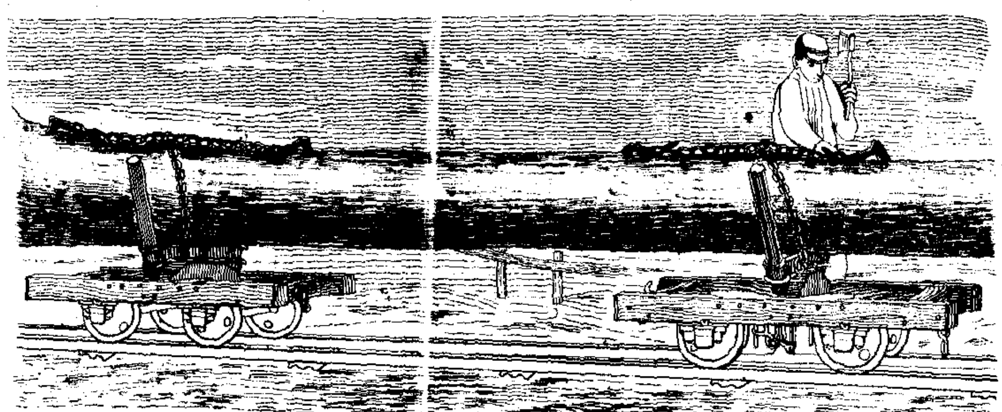
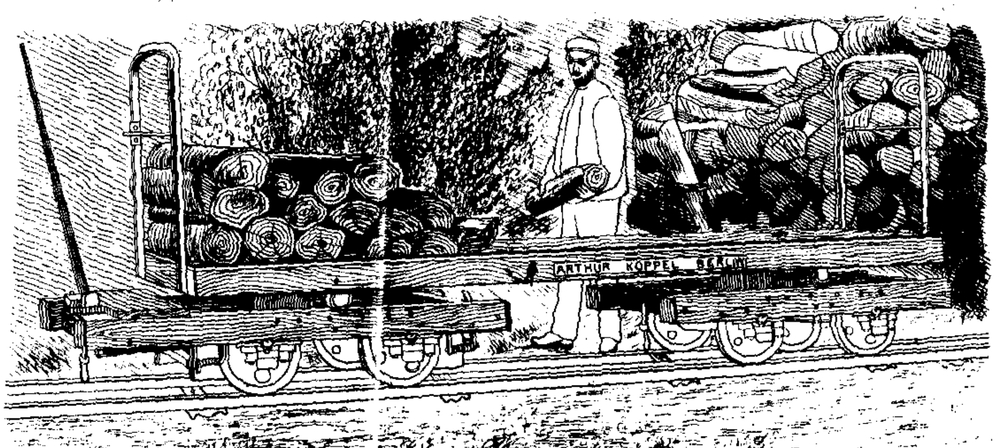


Fig. 3.



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WE congratulate Sir Dietrich Brandis, F.R.S., Ph.D., on his elevation to the rank of Knight Commander of the Indian Empire on the occasion of Her Majesty's Jubilee.

It is an honor which he has well deserved, and of which the Forest Department may be proud. As the heads of other Departments have been selected for decoration on this occasion, we should have been pleased to see the title of C.S.I. or C.I.E. conferred on Dr. Schlich, the present Inspector General of Forests, who is now at Cooper's Hill College, organizing a course of instruction in European Forestry for the Indian and Colonial Forest Service.

THE INDIAN FOREST SERVICE.

WE republish an article on the Indian Forest Service, which appeared in a recent Number of the "Indian Agriculturist," as it is well for us all to know what non-Foresters think of our work, and of the capacity required to manage forests successfully.

"It is announced that an open competition for the Forest service in India, will be held in London in June next, when not less than ten probationers will be selected. The examination will be open to all natural-born subjects of her Majesty, but they must be unmarried, and above 17, but under 21 years of age on the 1st of June, 1887. The subjects of examination form a somewhat wide curriculum of studies, in which the Latin and Greek languages give place to German and French. The service can have no attractions whatever for English youth, and as its conditions become known, it will much surprise us if any applicants whatever, present themselves to the examiners. For if the candidate is successful in the competitive examination, it does not by any means follow, that he will finally secure an appointment to the service. The competition is but the commencement of a series of examinations, recurring periodically, while the probationer is under what is called a course of training at Cooper's Hill College, extending over nearly two years, at an annual charge of £180, to be borne by his parents or guardians. At 22 or 23 years of age, and after an expensive education that cannot have cost his

parents less than £250 a year, from the time he was 14 years old :—if the boy's character is good, his physique strong, his sight and hearing perfect, and he can ride well, he *may* get an appointment in India, to the magnificent position of an Assistant Conservator of Forests on Rs. 250 a month, from the date of his arrival in the country. Particular stress is laid, in the rules for admission, upon the applicant's good vision and hearing. 'Means are taken to test his physical powers of endurance'—we hope not by making him qualify as a 'fasting man,'—and all these formidable preliminaries result in the chance of the young man securing an appointment in the forests and jungles of India, upon the extravagant pay of £170 to £180 a year (Rs. 250), with no prospect before him whatever. He must pass through no less than seven grades of the service, before he becomes a third grade Conservator, upon about £650 a year. It is a mockery and a snare, to parade such a service before English parents, who know little or nothing of the conditions of service in this country. Take the case of an English boy at 15 years of age, whose parents or guardians are prepared to *spend £2,000 upon giving him a fair start in life. Under this shameless* Cooper's Hill fraud the boy's friends are induced to spend £250 a year, for seven or eight years, upon his education, to procure for him the chance of spending his life in the jungles of India, upon a salary of £180 a year rising to £700. An English boy who has been under good tuition from 9 to 15 years of age, is well fitted to become an apprentice in any profession or business whatever, while if his friends have £2,000 at their command to give him 'a start in life,' they can place him with the greatest ease, in circumstances in which he may secure a junior partnership in the firm that has educated him, at the very same age at which the victimized candidate for a life in the jungles, is offered the magnificent salary of £170 a year. Cooper's Hill is a fraud upon both nations, while it is kept up at indefinite cost to the people of this country, who have already been made to pay well on to half-a-million sterling, for its foundation. It is necessary to speak plainly upon this subject. There is no reason whatever, why the Government should not have a large forest school in India itself, for training native youths for the exclusive filling of these jungle appointments. It may be, and no doubt is, desirable to have two or three highly-qualified men of European training, at the head of every provincial branch of the service, but that exhausts absolutely the need for European officers. And in a very few years' time, even *that* need will disappear, India herself producing a school of Forest officers, second to none in the world. The simple truth is that in the midst of endless protestations of our desire to rule the country wisely, every branch of the public service, upon one pretence or other, is made a preserve for Englishmen. Native youth, including the Eurasian community, are practically excluded, because their friends cannot possibly face the costly regulations, which require them to pass these ordeals in England. What person of common sense fails to see, that however real may have been the necessity for European guidance in the establishment of the Forest service, that need has now gone, and that it is in India itself that we should now recruit the service, without a thought of resorting to England for the purpose. The service has ceased to offer a career to English youth, and it is only to impose upon the mother-country, to keep up the pretence

of such a career for its sons. The schools of this city alone—such Schools as the City College, the Doveton, St. Xavier's, the Missionary schools, and others—are turning out every year, boys in large numbers, for whom all appointments in the Forest, Opium, Police, Land Settlement, Post Office, Telegraph, Railway, and Account Departments, should be reserved. England will still have not only her own *home service and colonies, but the highest appointments* in India as a legitimate career for her sons, while to train them highly and at the expense of India, for competition in the services that we have named, is a wrong both to the mother-country, and to its great dependency. The only satisfaction we have in reviewing matters, is the inclination of the Government to accept these views, but unless the public press drive the conviction home, the Government will move only with the proverbial slowness that characterizes its action in all reforms."

It will be seen that the writer wishes to secure the posts in the Forest Department entirely for native youths, and complains of the enormous cost of Cooper's Hill being saddled on India, and rates the ability required for "these jungle appointments" at rather a low figure.

It is generally admitted that the proper ground to take as regards the public service, is to secure the very best officers available to carry it on, and if young men of education in England come forward under the present conditions of the Forest service, and their guardians are willing to pay the high cost, at least £500, including outfit, of their training at Cooper's Hill, we fail to see why the "Indian Agriculturist" should complain. Admitting the necessity for the maintenance of the Cooper's Hill College for the Indian Public Works and Telegraph Departments, the fact that certain Forest students are to be trained there as well, at their own expense, tends really to diminish the cost of that institution.

We admit readily that the pay of the higher grades of the Forest Department does not correspond with that of the other Departments in India, and that with the present rate of exchange, the prospects of furlough for married Forest officers is very illusory, indeed furlough is now rarely taken except when an officer is compelled to do so by ill health, or by the necessity of providing education for his children. Pension also is a pittance, which without private means, or almost impossible savings, will not allow for retirement with any prospect of maintaining a family in comfort. In spite of these drawbacks, however, India is to be congratulated on the fact that, the Forest service still presents attractions to many young men of the United Kingdom, who like the wild out-door life in the forests and the freedom from sedentary occupations.

The writer of the paper in the "Indian Agriculturist" considers that highly trained men were required to organize the Forest Department, and that they have done their work so completely that though "a few of them may be still required, at the head of every provincial branch of the service .... yet even

that need will soon disappear," and the service in future should be recruited exclusively in India.

Now it may be conceded that, some of the present Forest divisions do not make much demand on a man's abilities, and that a good capacity for business, coupled with thorough integrity, and industry, and a strong frame and constitution, combined with sound common sense, in themselves qualities not very common in India, will suffice for the successful management of some remote Forest divisions, where the chief work is the maintenance of the forest areas intact, there being as yet little demand for produce. Such charges, however, are becoming rarer every day, with the rising demand for forest produce, whilst Forest divisions, such as those of the N.-W. Provinces and Oudh, where every kind of produce can be sold, require a high standard of professional education, the want of which may lead to mistaken treatment, with the very worst results to the future of the forests.

The popular idea is that, any one can manage forests successfully, and that waifs and strays of humanity, who have failed to obtain admission to other departments, can readily find a field for their exertions in the Forest service, and the "Indian Agriculturist" classes Forestry with a number of departments, which, except Telegraphy, do not require a special scientific training, as one peculiarly suited for men trained exclusively in India. The wisdom of our Government in classing Forestry with Public Works and constructive Telegraphy, and demanding a high preliminary standard of scientific education from men intended for the controlling staff of the Forest Department, is apparent, though it is not clear why the same privileges as regards pension and retirement, which have been accorded to the other departments, should not be extended to us, so that the three departments may be on an equal footing at Cooper's Hill, and the Forest service not merely obtain the residuum of the other competitive services. A sound preliminary scientific training can be afforded by the present arrangements for teaching Forest students at Cooper's Hill, as well as a purely general course of Forestry, but whether Indian Forestry can be better taught there or at Dehra Dún is another question, though the staff at the Dehra Dún Forest School is at present far too weak to undertake the instruction of the controlling staff of the Forest Department.

What the Dehra Dún School is now doing is to train a subordinate staff of Sub-Assistant Conservators and Forest Rangers, and if all the Local Governments and Native States would see that a properly guided and fairly well paid subordinate staff, with salaries ranging from Rs. 50 to 400 were provided wherever the forests are of sufficient importance to be subdivided into ranges, we might expect a competition of fairly educated men from the Indian Schools for these appointments.

Each province should also provide means for the practical

training of Forest Guards and Foresters in their duties, such as—coppicing, and cutting back inferior growth, clearing and pegging out straight lines for roads, surfacing and draining roads, economic burning of fire traces, charcoal making, management of nurseries and plantations, &c., &c., of which many of them are entirely ignorant at present.

After a strong subordinate staff of Forest Rangers has been trained by the Dehra Dún School, and the results of their work has been seen, the question of the training in Forestry of the Controlling Staff in India might be considered, but scientific education in India has not yet afforded any thing like a sufficient supply of properly qualified candidates for Rangerships, and Indian Forestry would be hopelessly thrown back, were the Controlling Staff to be taken from the class of men whom the "Indian Agriculturist" recommends. If only the men sent out from Cooper's Hill have received a thorough preliminary scientific training, we are quite willing that the Controlling Staff should be reduced in numbers to the absolute minimum consistent with efficiency, and by a careful arrangement of divisional forest charges, something may be done with this object in view; but it is probable, especially when we consider the requirements of Upper Burma, that the numbers of the Controlling Staff cannot be reduced below its present strength. Leaving out the important Native States of Mysore, Hyderabad, Baroda and others, where the Chief Forest officer and one or two others at any rate, should be thoroughly scientific Foresters, we consider that the Controlling Staff under the Government of India, besides the Inspector General of Forests, should comprise the following officers with the rank and pay of Conservators.

Assistant Inspector General and Superintendent of Forest Working Plans.

The Superintendent of Forest Surveys.

The Director of the Forest School.

Four assistants are required for the latter officers, who should all be highly trained in Forestry.

For the principal Local Governments, namely Bengal, N.-W. Provinces and Oudh, Punjab, Central Provinces and Lower Burma, there should be a Chief Conservator of Forests, who should be also Forest Secretary to Government, and this would ensure unity in the Forest administration, which the present subdivision of some provinces into several circles will not allow.

Another Conservator should also be added who will assist in inspection, and have special charge of Working Plans, directing the compilation of new ones and seeing that the provisions of accepted ones are carried out.

Two Working Plans officers will also be required for each of these provinces.

In Assam, Berar, and Coorg, only one Conservator, with one Working Plans officer, might suffice.

District Forest officer's charges should be as far as possible conterminous with districts, and the more important Divisions should carry the highest pay, and we should not see the present anomaly of promotion in the Deputy Conservator's grade, simply going by seniority. Smaller Divisions may be held by members of the Executive Staff, and no officer of the Controlling Staff should hold charge of a Division till he has managed an important range successfully. Considering the difficult nature of framing Forest Working Plans, and the absolute necessity of entrusting this work to the most scientific and experienced of the Divisional officers, the Working Plans officers should draw special allowances, in addition to their graded salaries.

They should also be in charge of the maps of the province under the Superintendent of Forest Surveys, but should be otherwise under the Conservator's orders.

The Controlling Staff for the Government of India, including an estimate for Upper Burma, would comprise besides the Inspector General of Forests, 17 Conservators, 14 Working Plans officers, 80 Divisional officers, and 28 Assistants = 140 officers, and to these we may add 30 officers for Madras and the same number for Bombay, though we are quite uncertain of the number required for that province, making a total of 200 officers for the Controlling Staff for the whole of India, exclusive of those required for the Chief Native States.

It is quite possible that as the Dehra Dún training tells, and a strong Executive Staff is formed in every province, that this number might be gradually reduced, but allowing for a sufficient number of men to learn their duties in charge of ranges, and to supply the places of officers on leave, it is impossible that the number of the superior Staff can be less than 160, at the very lowest, and the lower its number is fixed, the greater the necessity for obtaining men of the highest attainments for the work, so that the impossibility of the wish of the "Indian Agriculturist" to reduce the Forest Department to a quite subordinate position in India being carried out is plainly shown.

We may remark here that many men come up to the Dehra Dún Forest School to compete for the Executive Staff with the merest smattering of a knowledge of Arithmetic, and that it has been impossible for many of them to profit fully by the instruction at the School, and that the only hope of securing really competent men for the Executive Forest Staff, on which the future of Indian Forestry so greatly depends, is that each Government should thoroughly overhaul its list of appointments, and see that they are properly graded, and the work so distributed as to afford responsible charges and fair prospects of promotion for intelligent young men, who at present, to a large extent, only come to the Forest Department, in default of every other employment.

The sanctioned Executive Staff of the different provinces is at

present as follows, according to the last list of officers under the Government of India:—

Province.	Salary in Rupees.								Total.
	250	200	150	120	100	80 or 75	70 or 60	50	
Bengal, ...	2	2	3	..	...	2	3	14	26
Assam, ..	..	1	2	...	...	1	4	5	13
N.-W. P. and Oudh,	1	2	1	...	1	2	5	7	19
Ajmir, ...	...	...	1	...	...	...	...	1	2
Punjab, ...	...	4	3	1	1	2	3	13	27
Central Provinces, ...	2	3	1.	...	3	4	5	10	28
Coorg, ...	...	...	...	...	...	...	1	1	2
Berar, ...	...	1	2	1	...	...	3	5	12
Burma, ...	...	1	4	1	2	3	4	13	28
Total, ...	5	14	17	3	7	14	28	69	157

In Madras we find the following Executive Staff:—

Salary in Rupees.							Total.
200.	150.	125.	100.	80.	60.	50.	
7	6	2	4	10	12	15	56

This contrasts most favorably with that of the Government of India, where nearly half the appointments are on Rs. 50, and there is in several Provinces very little chance of promotion for years to come to promising men trained at the Dehra Dún School.

We regret that we cannot give the list of appointments sanctioned in Bombay, but hope that one of our friends there will furnish it for our next Number.

What is required for each Province in India is a re-classification of all forest divisions and ranges, in the most careful way, so that class of work may be commensurate with the pay of the post throughout India, and the Forest service will then present as fine a field for a man's energies and for the study of Biology as can be desired.

TABASHEER.

I wish, through the medium of the "Indian Forester," to draw the attention of my friends and former colleagues, as well as of

younger Forest officers in India generally, to this remarkable substance, because the study of its formation may possibly lead to important results concerning the life history of the large bamboos, in the hollow joints of which it is deposited. Its great, and I may add unmerited, fame as a medicine, this substance has received mainly through the writings of the old Arab physicians, particularly of *Razi* + 923, and of *Ibn Sina* (better known as *Avicenna*) + 1,037. But the name is of Sanskrit origin *tvakkshíra, tavakkshíra*, meaning milk in the skin.

The oldest detailed account of this substance known to me, is contained in a letter from Dr. Patrick Russell to Sir Joseph Banks, dated Vizagapatam, November 26th, 1788, printed in Vol. 80 (1790) of the Philosophical Transactions of London. He notices the erroneous account given by Arab writers of its origin through the burning of bamboo stems, especially of such as have suffered from fire kindled by the friction of the reeds one against the other, an accident, he adds, supposed to happen frequently in the dry season among the hills, and he mentions that in the Latin versions of Razi and Avicenna, tabasheer is constantly but erroneously rendered by *spodium* (ashes). He adds, that the mountaineers, referring probably to those of the Vizagapatam district, say, they never look for tabasheer in the half burnt fragments of the bamboo. Here I may mention at the outset, that the erroneous notion, that tabasheer is obtained from the ashes of bamboos, is still current in books in Europe. Tabasheer was also formerly confused with sugar, this error, however, was cleared up by Rumphius (Herbarium Amboinense, IV., 11). He says that the *sugarcane* has been confused with the bamboo and *sugar* with tabaxir, also called Sachar Mamboe. Rumphius wrote his large and excellent work about 1690, and it was published in 1750. Colonel Yule, in his delightful book "A Glossary of Anglo-Indian words (1886) enters fully into this interesting question, and shows the absurdity of the idea, which has long been entertained, that the *saccharon* of Greek and Roman writers was not sugar but the siliceous concretion sometimes deposited in bamboos (pages 654 and 675).

The account of Dr. Russell's own researches forms the most interesting portion of the papers. After mentioning, that tabasheer is only found in the joints of the female bamboo (in this case probably *Bambusa arundinacea*), he explains that on shaking the bamboo, a rattling noise indicates the existence of tabasheer in large pieces, and that these are bluish white, like fragments of shells, but softer in substance. In other cases there is only a rough friable white or cinereous powdery substance adhering to the inner wall of the joint.

In April he examined a bamboo of six joints received from Vellore (probably the place on the Palar river west of Madras is meant). On splitting it, no vestige was found in two joints, these were discolored within. The whole quantity collected

amounted to 27 grains, and the largest quantity was obtained from the two middle joints. A small portion, about four grains, consisted of bluish white solid pieces, but soft, the rest was cinereous and friable.

In July, 37 bamboos were split out of a large quantity of green bamboos, each containing 5-6 joints, which had been brought from the hills 50 miles distant from Vizagapatam. In nine of these no vestige of tabasheer was found, the remaining 28 yielded small quantities, in the aggregate not much exceeding 2 drams (54$\frac{19}{8}$ grains). The substance was never found in more than three joints of the same bamboo, and the empty joints were sometimes contiguous, sometimes interrupted. The white smoother and harder particles adhered to the septum and to the sides at the ends, never to the middle. Instead of being chiefly found at the lower extremity of the joint, as might be expected from the sap settling there, they were found adhering indifferently to either extremity, and sometimes to both, forming a smooth lining, somewhat resembling polished stucco, generally cracked in several places, which could readily be detached with a blunt knife. In some joints the tabasheer was thus collected at one or both extremities only, and in such no rattling was perceived, but generally, while some adhered to the extremities of the joint on the inside, other detached pieces were intermixed with the coarser loose particles in the cavity.

Tabasheer has been repeatedly analysed. In one point all analyses agree, that it chiefly consists of silica, the proportion varying between 70 and 90 per cent., with a small quantity of moisture and organic matter. The other principal substances are lime and potash, but their proportions seem to vary. (See Turner's Analysis of Tabasheer, Edinburgh Journal of Science, XVI., 335, and T. Thomson, quoted on page 257 of the Pharmacopœia of India). The silica, lime and potash were doubtless originally held in solution in the sap, which is taken up by the roots from the ground. The sap which fills the cells of the growing bamboo-shoot, holds these inorganic substances in solution, together with sugar, gum and other organic substances which have been elaborated by the action of the leaves. As the shoot grows older, cavities are formed in the joints, and in these cavities some of the sap collects from the surrounding tissues. The existence of this watery fluid in the hollow joints of the bamboo is well known to all who have spent some time in the bamboo forests of India and other tropical countries.

There is little doubt, that tabasheer is the residue of this fluid, but it is not clear how it is formed. In any case, however, the fluid in the hollow joints is intimately connected with tabasheer, this seems also to have been Dr. Russell's view of the process, and accordingly he paid attention to the fluid found in the joints of the bamboo. The existence of such fluid, he observes, may be known by the sound when the joint is shaken. He

never found fluid in more than two joints of one stem, and never in large quantities, 1½ ounces being the largest amount obtained from one stem. He adds that the fluid always had a slightly saline and astringent taste, that it was always transparent but varied in color and consistency. Some of a darker color had the consistency of honey, some on the other hand was perfectly colorless but nearly dry. Both kinds, he says, had the sharp salt taste of fresh tabasheer.

Dr. P. Russell also mentions, that in the bazars of Hyderabad two sorts of tabasheer are sold, the best at one rupee a dram, the inferior kind at half that price, the latter consisting chiefly of burnt teeth and bones. A Parsee informed him, that tabasheer was produced in great quantities in Sylhet, and sold there at Rs. 1 to 1-8 per pound, also that it formed a considerable article of trade from Bengal to Persia and Arabia.

A later volume of the Philosophical Transactions (for 1819), contains an important article by Sir D. Brewster on the very remarkable optical and physical properties of tabasheer. In that article Brewster mentions also, that Humboldt discovered tabasheer in the bamboos which grow to the west of the *Pinchincha* in South America.

About 10 years later Sir David Brewster published in No. XVI. of the Edinburgh Journal of Science, additional observations on the natural history of tabasheer, together with some remarks on the subject by Dr. Wilson, at that time Secretary of the Asiatic Society, Calcutta, who speaks of it under the Bengali name *bans lochan*. In the Calcutta market, Dr. Wilson says, three sorts are sold. The best is called Patnai, because it is brought from Patna, small solid pieces of milky white color and half transparent. This kind is also called Nilkanthi on account of its bluish color, and Paharika, because it is brought from the hilly country west of the Ganges. The second sort is white, dull and friable; neither shining nor transparent; it is called Chhelata, and is supposed to be brought from Sylhet. The third and least valuable kind is called Desi. Regarding the first kind (Paharika) Dr. Playfair at Hazaribagh wrote to Dr. Wilson that it was obtained from the hilly country of Chutia Nagpore, 6–100 miles from Hazaribagh, and from Palamow. It is found in the small hill bamboo, under which I suppose we must understand *Dendrocalamus strictus*, and out of 50 or 60 plants only five or six yield it. A stem contains as a rule 4-5 grains, and very rarely it happens that 40-50 grains are found. The same stem often yields the three kinds, the best, which is shining and bluish white, the second sort white, like chalk, not shining, and the third brown and sometimes even black. The raw material sells at the rate of 10 Rupees a seer, but after it has been prepared for use, the same quantity costs 40-50 Rupees. This preparation consists in heating it in a crucible of clay and maintaining it at red heat for some time. When heated the *bans lochan* at first

becomes black (by the carbonization of the organic matter which it contains, but after the organic matter has been completely consumed, the substance becomes white again after cooling. One-and-a-half ounces of the natural tabasheer treated in this manner, yield one ounce of the prepared substance.

Sir David Brewster expresses a remarkable view regarding the formation of tabasheer. He thinks that it must be the result of a disease in the bamboo of a disorganized state in the transverse walls, which separate the joints. He adverts to the statement made by an intelligent native of Vizagapatam, that the walls of these joints which contained tabasheer are always perforated by holes made by an insect, but adds correctly that tabasheer is often found in joints which have no such holes.

The conclusion to which he had arrived, seems to be that the sap is collected in the transverse wall which separates the joints, *and that when the tissue of this wall gets diseased, or when the* membrane which clothes the inside of the joint is injured, the sap which holds the silica in solution, filters through into the joint, and on drying up leaves the tabasheer.

The remainder of the paper is devoted to an account of the remarkable physical qualities of this substance, which it would lead too far to reproduce here.

The editors of the German Periodical, in which the translation of Brewster's papers is published* (Journal für Chemie und Physik, Vol. 52, 1828) add some further information regarding *tabasheer. A green bamboo, grown in a conservatory near* London, was found to contain a small hard round pebble in one of its joints, of a dark blackish brown color. Again it has been reported by Dr. Moore (Edinburgh Journal of Science, IV., 192) that concretions similar to tabasheer were found in the nodes of a large kind of grass which grows between "Nagpore and the Circars."

These are the most detailed researches published, and I will now give a brief account of the statements made by other authors on the subject of tabasheer.

Rheade (Hortus Indicus Malabaricus, Vol. I., 25) merely says: "stipites hujus arboris (*Ily, Bambusa arundinacea*) cum vetustiores sunt, aliquo genere calcis in cavitate obducuntur, quae usui medico servatur."

Rumphius, Herbarium Amboinense, Vol. IV., 10, mentions that the younger stems of bamboos contain in their lower joints a colorless fluid fit for drinking, and that in other countries, particularly in some provinces of India proper (in quibusdam Indiæ veteris provinciis) it leaves a white substance similar to lime, which is called *tabaxir*. In the Indian Archipelago he *distinctly says that this substance is not found in the joints of*

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* The extracts here given are taken from the translation as I had not the original here to refer to.

bamboos, and adds that in one place only (in Hituae ora) a similar substance was once brought to him by his servants.

Mason (Burma, 1860, 503) merely says that some of the bamboos of Burma secrete a silicious substance, called tabasheer, which has a place among native medicinal substances: he adds the Burmese name, which means stone out of the bamboo.

In the new edition published by Mr. Theobald (1883), the latter states (Vol. II., p. 102) that the fluid, which is contained in the joints of bamboos "is often limpid and a grateful drink when no other water is procurable in the forest, but as it dries up it becomes milky, and finally deposits a cake of gelatinous opaline silica at the bottom of the joint, known as *tabasheer*, possessing curious optical properties." He adds: "these little discs of *tabasheer* may often be picked up in a bamboo forest, after the bamboo which yielded it has decayed; and when a bamboo forest has been destroyed by fire, these white calcined discs form quite a noticeable feature of the ground, especially when a shower of rain has removed the white pulverulent ash."

The late Sulpiz Kurz in the excellent paper, which he communicated to the first volume of the "Indian Forester," mentions the water in the bamboo joints, which often quenched his thirst during his tours in the Java hills, and he adds that "tabasheer is a siliceous whitish floury substance, which is found as a secretion, or more probably as a residuum in the interior of the joints of several species (especially *Bambusa arundinacea*) often up to an inch in thickness," (page 239).

During my forest wanderings in India, particularly in Burma, I have often seen the fluid contained in the joints of bamboos, and have drunk it. In those days I endeavoured to ascertain more particularly the conditions under which sap is found in the cavities of the joints, but did not come to any definite result. I have seen the deposit of silica on the inside walls of the joints, but never in such large quantities as mentioned by Kurz, nor do I remember having seen the discs of tabasheer described by Mr. Theobald. But I must add, that, during my Indian career I never found time for continued scientific research. The difficulties of first organization were too great, and the battle against those, who opposed forest conservancy, was too severe in those days to leave me any leisure for systematic study. The Foresters of the present day are in a much more favorable position, and hence I venture to hope that the present remarks may induce some of them, to study this subject on the spot in the forest.

So much is known for certain, that tabasheer is found in Sylhet (probably also in Assam), in Chutia Nagpur, in Burma and in the Peninsula, both on the east, as well as on the west side. Indeed I am disposed to think that it is formed in the joints of all large bamboos, at least in the Tropics. From what Rumphius says, one might doubt the formation of it in the

extensive bamboo forests of the Indian Archipelago. But Kurz, when speaking of tabasheer in the passage quoted above, probably referred to his previous experience in the Archipelago, and I am disposed to think that Rumphius, though an excellent observer generally, may possibly, in this particular instance, have been mistaken. In a Dutch scientific periodical ("Tijdschrift voor natuurlijke geschiedenis en Physiologie," 1836, p. 13) I find the following notice in a letter from Dr. Korthals, written at Padang (Sumatra) in February 1835. "In the stems of several bamboos a considerable quantity of water is found. This water, which is mostly 4—6 degrees Centigrade below the mean temperature of the air, seems to contribute towards the formation of the gelatinous siliceous substance, which sometimes occurs in the bamboos and is precipitated out of that fluid." It does not, however, follow from this passage, that tabasheer was found by Dr. Korthals in Sumatra.

These are the main data, which I have been able to gather upon this subject. Before explaining my suggestions regarding the researches which I venture to hope will be undertaken in the bamboo forests of India and Burma, it may be useful briefly to sketch the ideas which I have formed at present regarding the formation of tabasheer in the living bamboo stem.

When the young bamboo shoots first make their appearance, they consist of a continuous mass of soft fleshy tissue. Only gradually, as the internodes lengthen out and the joints become visible, hollows are formed in the joints. At that time the shoots have no side branches, they generally bear only a few leaves of the ordinary kind at the end of the stems, and in this state the substance of the joints is soft. This is the stage at which the wood fibres can readily be separated and made into paper stuff. Towards the end of the first rainy season however, the development of lateral branches commences, and at the same time the joints become hard by lignification and by the deposit of silica in the cells and fibres near the outer surface of the stem. After this process of induration has progressed to a certain point, the separation of the wood fibres becomes difficult, and at that more advanced stage the bamboo stems can no longer be used for the manufacture of paper stuff.

The silica which is used in the process of induration, is taken up from the soil by the roots, and the sap which fills the vessels, fibres and cells of young bamboo stems, must, therefore, at the time, that the process of induration has commenced, hold silica in solution, possibly in combination with other substances. Evaporation goes on at a great rate through the leaves, the sheaths and the surface of the internodes, while, under the influence of the light, the carbonic acid taken up from the air, together with the water, nitrogen and mineral salts taken up by the roots, are transformed into the substances forming the tissue of the growing stem. The silica gradually accumulates, and the result of

this accumulation is the induration of the outer portion of the stem. The process is analogous to the accumulation of lime in old leaves, to which I drew attention in the "Indian Forester" of February 1886 (p. 58), with this difference, that the leaves of *Pinus Laricio*, to which my remarks at that time related, take three years to increase the proportion of lime in their ash from 15 to 70 per cent., whereas in the bamboo stems the accumulation of silica is accomplished in a few months.

Some of the sap, with which the cells of the tissue are filled, collects in the cavities of the joints, and as already stated, the tabasheer is produced from this fluid, though the manner in which it is formed is by no means clear. Tabasheer contains from 70 to 90 per cent. of silica, and only from 10 to 30 per cent. of other substances, including moisture. It is probable, that the living sap in the tissue of the bamboo stem *contains a much larger* proportion of other substances. Tabasheer cannot, therefore, be regarded simply as the residue of the substances held in solution by the sap. Again, it is not clear how the water of the sap is got rid of. When insects have tapped the joints and have perforated the walls, the sap contained in the hollows evaporates rapidly, and such joints are always I believe dry. Some evaporation may, perhaps, take place through the walls of joints in a sound condition, but I doubt whether that is sufficient to account for the formation of tabasheer. Apparently a process of secretion takes place, which has some analogy to the secretion of resinous substances and to the formation of crystals of calcium oxalate and other substances in the living tissue.

So much is certain that the subject requires further study, and that such study may lead to important results regarding the life history of the bamboo. The enquiry should bear, both upon the fluid in the joints and upon the tabasheer. In all cases it will be necessary to note the species of which any stems have been examined, the systematic as well as the vernacular name, and in case the former should not be known with certainty, specimens for identification should be collected, of the large sheaths upon the young shoots, of leaves, and whenever possible, of flowers. Soil, elevation and other circumstances, which may have influenced the growth of the bamboo should also be noted.

As mentioned already, young shoots are solid, that is to say, they are entirely filled with soft tissue, and the hollow of the joint only forms gradually, as the stem grows older. It will be interesting to study the formation of this cavity in different species and under different circumstances. At first I suppose the cavity is entirely filled with sap. Gradually the sap disappears in some joints, and endeavours should be made to determine which joints remain filled with sap, and for how long. It will be useful to measure the capacity of the joint, which can

be done with sufficient accuracy by measuring length and diameter of the cavity, and the quantity of fluid contained in it should be determined by means of a graduated cylinder. The quantity of solid matter held in solution in the fluid should be ascertained by evaporation. As far as I remember, the fluid in the joints is tasteless, but a sharp saline and astringent taste has been ascribed to it by some authors. This uncertainty should be set at rest, it should further be determined, whether the reaction is acid or alkaline, and whether in the joints of older stems the fluid gets gradually thicker and assumes the consistency of honey.

As regards the tabasheer itself, it would be important to ascertain, in which species it is found, and particularly whether it is really found in the smaller kinds also, such as *Dendrocalamus strictus*. Further, in which joints it occurs. The precise manner of its occurence, either in the substance of the tissue or as a lining of the cavity, or in loose pieces in the hollow joints should be described in detail, and it would be well to ascertain further particulars regarding the discs of tabasheer mentioned by Mr. Theobald.

I do not know, whether tabasheer is still collected any where on a large scale in India. Should this be the case, it would be interesting to learn particulars regarding the method employed in collecting it, the quantities obtained per stem, its further preparation by calcination or otherwise, the price at which it is sold, and the quantity exported.

Professor Ferdinand Cohn at Breslau, who is well known by his researches in different branches of anatomy and physiology of plants, is specially interested in tabasheer, and would be glad to receive communications on the subject. It might also be useful to send him samples of the tabasheer collected, and of the substances held in solution in the fluid and obtained by evaporation. I shall myself be glad, if desired, to aid in these researches by ascertaining the correct systematic name of bamboos, of which specimens may be sent me, or otherwise.

In conclusion, I may add, that a complete list of the names of tabasheer in the different Indian languages will be found on page 65 of Moodeen Sheriff's Supplement to the Pharmacopœia of India, Madras 1869.

BONN, *December 1886.* — D. BRANDIS.

GRAZING IN FORESTS TREATED ON THE JARDINAGE SYSTEM (SELECTION FELLINGS).

YOUR correspondent's letter which appeared in the December number of the "Forester" asks for a solution of one of the most difficult problems in Indian forestry, *viz.*, how to ar-

range for cattle grazing in forests treated on the jardinage system.

As far as the welfare of the forest is concerned, it is a fact generally admitted that cattle grazing should not be allowed in a forest treated on the jardinage system, and the reason for this is not far to seek. We have only to bear in mind the condition and distribution of the growing stock of a *forêt jardinee*, or "forest treated on the system of selection fellings," which is represented by a collection of trees of all ages intermingled over the whole forest. The best example we have of what *forêt jardinee* should be, is a virgin forest where fires, cattle and the axe have never entered. Such examples are not rare in the case of sholas or masses of evergreen forest, many of which can still be seen on the higher ranges of hills in the Madras Presidency and I presume elsewhere, and here it is we can study the natural *forêt jardinee*. The leaf-cover (*massif*) is continuous, *trees of every age are intermingled over the whole forest, there* is no grass and but little undergrowth, and when one of the old veterans falls down, a younger tree soon takes its place and fills up the gap.

Virgin deciduous forest.—Such examples, however, in the case of deciduous forest are much less common, as a rule their accessibility renders them an easy prey to their three enemies, man, fire and cattle. The only virgin deciduous forest I have seen is situated in an inaccessible portion of the Anamalai Hills. Its condition, however, is practically the same as that of virgin evergreen forest, and there is but little grass or scrubby undergrowth.

In framing a working plan for such a forest we must follow nature's teaching, so long as we fell only the mature trees, and make proper arrangements for keeping out fire and cattle the forest will be maintained in its natural state, with the sole exception that we shall not allow trees to attain a greater age or diameter than that required by the *exploitabilité* prescribed by the working plan. Our object will generally be to grow trees of a diameter most useful to the consuming public. In framing a working plan *for such a forest cattle grazing should be* prohibited, as the cattle finding but little grass would naturally turn their attention to the young seedlings.

Forests not in a state of continuous leaf cover ("massif complet").—We next come to the forests which are not in a state of "continuous cover" (*massif*), these are unfortunately the most common in this Presidency, and tax the skill and ingenuity of the Forester to improve them. They may be grouped as follows :—

(*a*). Forests growing on the slopes of hills.

(*b*). Forests growing on plains or plateau.

(*a*). *Forests growing on the slopes of hills.*—In such forests the growth is, as a rule, poor, and the more the forest is opened the

poorer it becomes, as the humus and soil get washed away. In framing working plans for such forests, cattle grazing should be prohibited, as grass and shrubs are the most valuable auxiliary we have in protecting the young seedlings, and in disintegrating the rock, and so forming soil. Further, on hill slopes cattle loosen the soil, which is washed down when the rains begin.

(b). *Deciduous forests growing on plains or plateau.*—When such forests are much opened a rank growth of grass, shrubs and thorny creepers at once springs up, and is a source of great danger, as it chokes the seedlings, and unless the most stringent precautions are taken, fire is sure to enter. It has been asserted that in such a forest, cattle are most beneficial in aiding natural reproduction. That they eat and trample down the grass cannot be denied, but that they also trample down and bite off the tops of the seedlings must in common justice also be admitted. How then to get rid of the grass? A correspondent in one of your former Numbers, stated that in forests properly protected from fire, the grass after a time falls down and dies. At the time I was rather sceptical about the truth of this statement, as I had in my mind's eye a forest, which had been protected from fire, and cattle excluded for four consecutive years, and the grass showed no signs of dying out. The fifth year is now nearly completed, and the Forester in charge of the forest reports that the grass is dying and that seedlings are everywhere coming up.

There is no doubt that grazing in forests of this nature, is less injurious than in those situated on the slopes of hills. But the damage done in any case is only a question of degree, and the advocates of cattle grazing, who state that it is most beneficial in aiding natural reproduction, have deduced their theory from an imperfect study of what really happens. Unfortunately the theory instead of being taken for what it is worth, has been accepted by those who wish for an easy solution of the difficulty of how to satisfy the demands of the cattle owner, and at the same time to preserve and improve the forests.

Far better would it be to face the truth, and to admit that cattle grazing is invariably more or less injurious to the forest, than to accept an erroneous theory as an easy method of getting over a difficulty.

The above is a brief survey of the case from a Forester's situation. But, in cases where grazing rights have been admitted, and where such rights have not been commuted, we must make the best arrangements we can, and the following plan might be adopted. Take, for example, the case of a mixed forest of teak (*Tectona grandis*), rosewood (*Dalbergia latifolia*), vengai (*Pterocarpus Marsupium*), terminalias, &c., and let us suppose that a rotation of 120 years has been adopted and divided into four periods each of 30 years' duration. The trees should then

be divided into four classes, the first class containing trees which are now of a marketable size, say 2 feet diameter and above, the classes will then be arranged as follow :—

1st class,	2 feet diameter and above	to be felled during	1st period.
2nd „	$1\frac{1}{2}$ to 2 feet diameter	to be felled during	2nd „
3rd „	1 to $1\frac{1}{2}$ feet	„ „ „	3rd „
4th „	under 1 foot	„ „ „	4th „

The rotation of 120 years has been adopted on the supposition that it will take a teak tree on an average 120 years to attain a diameter of 2 feet.

After making a valuation survey of the forest either by counting and measuring each tree, or else by means of linear valuation surveys, the trees will be arranged in their proper classes. The first class trees will be felled during the 1st period, the second class trees during the 2nd period, and so on. It will be necessary to deduct a certain proportion from the number of 2nd, 3rd and 4th class trees, as it cannot be expected that under the most favourable circumstances they will all come to maturity.

If the number of 1st class trees be divided by 30, the capability of the forest during the 1st period will be determined.

We will suppose the number of 1st class teak trees to be 9,000, the annual yield will, during the 1st period, be 300 teak trees.

The forest may then be divided into 30 coupes, in such a way that each coupe contains approximately *300 1st class teak trees.*

As the forest is a mixed one it cannot of course be arranged that the coupe, the limits of which have been selected, so as to contain the required number of teak trees, will contain the exact number of jungle wood trees determined when calculating the capability. If the required number is found in the coupe so much the better. But it must be laid down in the prescriptions of the working plan—

(*a*). That the limits of the coupe are never to be exceeded.

(*b*). That no tree under 2 feet diameter is to be felled.

(*c*). That in cases where the number of *1st class trees* (*in a* coupe) exceeds the capability, the number determined when calculating the capability must not be exceeded.

The coupe should be closed against grazing for two years before, and eight years after, the felling, as cattle on level ground trample down the soil and render it ill-adapted to the reception of seeds. If the coupe be closed for eight years after felling, and precautions taken to keep down the growth of thorny creepers, a certain number of seedlings will have a chance of coming up and attaining a fair size before cattle are again allowed to enter.

When the forest has once got into working order, it will be observed that each coupe is closed for 10 years of the period and

opened for 20. Two-thirds of the whole forest will thus be open for grazing.

The above is only a rough outline, and it may be necessary to shorten the periods if local conditions demand it.

I do not consider it a satisfactory solution of the difficulty, as a large proportion of seedlings must be destroyed by the cattle. If, however, local conditions necessitate the jardinage system, and cattle grazing has to be provided for, I can see no other way out of the difficulty. But I am inclined to think, that except in forests situated on steep hill slopes, where cattle grazing must in time, no matter what system be adopted, cause denudation, the best system to adopt would be either the *mode des e'claircies* or *taillis sous futaie* (coppice with standards). But it should be clearly understood that grazing is not essential to the well-being or improvement of the forest; unfortunately its existence is often a necessary evil, and when such is the case the working scheme must provide for it.

January 14th, 1887. "MASSIF COMPLET."

LIST OF TREES IN THE MELGHAT FORESTS.

THE following will interest some of your readers I hope; being the names of some of the trees in Berár. The names in the Melghát of Berár often differ from those elsewhere in Berár, and after those which *I know only as Melghát names, I have* placed an M., and B. and M., where the Berár and Melghát names agree :—

Saccopetalum tomentosum,	... Hum-Humba, M.
Dillenia pentagyna,	... Suaruk, M.
Cratœva religiosa,	... Barmál, M.
Cochlospermum Gossypium,	... Ganér, B. and M., Chaor, M.
Flacourtia Ramontchi,	... Gurgúti, M.
Kydia calycina,	... Bothi, M.
Bombax Malabaricum,	... Semal, B. and M., Sáodi, M.
Sterculia urens,	... Karái, M., Teklej, M.
" villosa,	... Kuthâda, Kudal, M.
Helicteres Isora,	... Morarphal, B. and M., Korajbothi, M.
Eriolæna Hookeriana,	... Arang, M.
Grewia tiliæfolia,	... Dháman, B. and M.
Feronia elephantum,	... Kabít, B. and M.
Ægle Marmelos,	... Bel, B. and M.
Ailanthus excelsa,	... Márup, B. and M.
Balanites Roxburghii,	... Hingan, B.
Boswellia serrata,	... Sálai, B. and M.

(I saw this in full flower in the Kinwat forest in south-east

Berár in January, 1886, and in flower in the Melghát in January, 1887. *See* Brandis, page 62).

Garúga pinnata,	... Kekda, M.
Melia indica,	... Ním, B. and M.
„ Azedarach,	... Bakain, B. and M.
Soymida febrifuga,	... Rohin, M.
Cedrela Toona,	... Goriya Ním, M.
Chloroxylon Swietenia,	... Bera, B. and M.
Celastrus senegalensis,	... Bekal, B. and M.
„ paniculata,	... Pingual, M.
Elæodendron Roxburghii,	... Jamrassi, B. and M., Niru, M.
Zizyphus Jujuba,	... Bher, B. and M., Boray, M.
„ rugosa,	... Chúrni, M.
„ xylopyra,	... Kather, B., Ghóta M.
Schleichera trijuga,	... Kusam, B. and M., Báru, M.
Odina Wodier,	... Mohin, M., Moyna, B.
Semecarpus anacardium,	... Bhiláwa, B. and M., Choso, M.
Mangifera indica,	... Am, B., Amb, M.
Buchanania latifolia,	... Char, Chironji, B. & M. Tárop, M.
Spondias mangifera,	... Kátamba, M.
Indigofera (sp.),	... Bilúri, B. and M.
Sesbania ægyptiaca,	... Shewari, B.
Erythrina indica,	... Pángra, B. and M.
„ suberosa,	... Nangtháda, M.
Butea frondosa,	... Palás, B. and M., Parsa, M.
„ superba,	... Túnáng, M.
Ougeinia dalbergioides,	... Tewas, B. and M., Rúthú, M.
Dalbergia latifolia,	... Sissu, B. and M.
„ paniculata,	... Passi, B. and M.
Pterocarpus Marsupium,	... Beula, Ragatroru, B., Bija Sál, B. and M.
Pongamia glabra,	... Kuranj, B. and M.
Cæsalpinia sepiaria,	... Wál, B.
Bauhinia purpurea,	.. Koilári, B. and M.
„ racemosa,	... Apti, B., Bossái, M.
„ variegata,	... Kachnár, B. and M., Champa, M.
„ vahlii,	... Maulwa, Maul, M.
Hardwickia binata,	... Anjan, B.
Tamarindus indica,	... Imli, B. and M., Chichá, M.
Cassia Fistula,	... Amaltás, B. and M., Bánákábhúngru, M.
Cassia auriculata,	... Tarwas, B.
„ Tarota,	... Tarota, B.
Prosopis spicigera,	... Saunder, B.
Albizzia odoratissima,	... Chichwa, B. and M.
„ procera,	... Kíní, B. and M.
„ Lebbek,	... Siris, B. and M.
Acacia arabica,	... Babul, B.

Acacia leucophlœa,	... Hewar, B. and M., Rinjra, M.
„ Catechu,	... Khair, B. and M.
„ ferruginea,	... Son babul, B.
Terminalia bellerica,	... Behéra, B. and M.
„ Chebula,	... Hilda, B. and M.
„ Arjuna,	... Arjun, B., Kahú, Kowa, B. & M.
„ tomentosa,	... Ain, Sáj, Sáddra, B. and M., Athna, M.
Anogeissus latifolia,	... Dhaura, B. and M.
Eugenia Jambolana,	... Jamun, B. and M., Jámbu, M.
Careya arborea,	... Kumbi, B. and M.
Woodfordia floribunda,	... Douri, Dhing, M.
Lagerstrœmia parviflora,	... Lendia, B. and M., Chekrej, M.
Casearia tomentosa,	... Késa, M.
„ graveolens,	... Rawít, M.
Anthocephalus Cadamba,	... Kaddam, B.
Stephegyne parvifolia,	... Kaddam, B. and M., Kuram, M.
Adina cordifolia,	... Haldu, B. and M.
Hymenodictyon excelsum,	... Bhorsál, M.
Gardenia turgida,	... Pendra, M.
Randia uliginosa,	... Púrputá, M.
„ dumetorum,	... Ghétu, M.
Embelia ribes,	... Bhringeli, M.
Bassia latifolia,	... Mowa, B. and M.
Mimusops indica,	... Khirni, B.
„ Elengi,	... Mulsári, B.
Diospyros Melanoxylon,	... Tendu, Temru, B. and M.
Schrebera swietenioides,	... Moka, B. and M., Jháw, M.
Wrightia tinctoria,	... Kúrá, M.
Holarrhena antidysenterica,	... Dudhi, B. & M., Kúrákatto, M.
Cordia Myxa,	... Gondhan, B., Chílu, M.
„ McLeodii,	... Laurikasmar, M.
„ Rothii,	... Gondhan, M.
Calosanthes indica,	... Phalgatétú, M.
Spathodea xylocarpa,	... Tetu, B. and M.
„ falcata,	... Mersing, M.
Stereospermum suaveolens,	... Padár, B. and M.
Tectona grandis,	... Sígwan, B. and M., Sípna, M.
Gmelina arborea,	... Siwan, B. and M., Kásmár, M.
Vitex Negundo,	... Samálu, B. and M., Nirgudi, M.
Ficus bengalensis,	... Bar, B. and M., Wadá, M.
„ religiosa,	... Pipri, M., Pipal, B.
„ infectoria,	... Páhkar, M.
„ glomerata,	... Gular, B. and M., Láwá, M.
Ulmus integrifolia,	... Chilár, M., Káránjalam, M.
Mallotus philippinensis,	... Kúkú, M.
Briedelia retusa,	... Karkha, M.
Lebidicropsis orbicularis,	... Ghara, B.
Phyllanthus emblica,	... Aonla, B. and M.

Dendrocalamus strictus, ... Bhans, B. and M., Mát, M.

In my Working Plan for a portion of the Beiraghar Forest I called Padár, S. chelonoides. It is S. suaveolens.

February 1887. G. J. VAN SOMEREN.

FUTURE ORGANIZATION OF THE FOREST DEPARTMENT.

I AM very glad to see that "Veteran" has followed the lead of "G. J. v S." in ventilating this subject, particularly as they adopt so admirably cool and contained a tone, the only one which can perhaps benefit a despised, because powerless, minority. I should long ago have addressed you on this subject, but that I felt it would be unwise and unsafe to publish abroad my feelings at being branded (in the matter of leave and pension) as inferior to the Public Works and the Telegraph Departments. There is I think a very general feeling that had we been numerically and influentially equal to those Departments, we should not have been left out in the cold. To get this injury cancelled must be the first step.

Of course there must be in Bombay a Head of the Department, or Secretary for Forests. There would have been one long ago, but that we have all along been, and are still, looked upon with jealousy as interlopers by Revenue officials in general. This jealousy is occasionally very painful and ruinous. I have known in the Bombay Presidency large areas of prospective forest, after Sir Richard Temple's time, simply *swept*, because the people knew they had the sympathies of the subordinate Magistrates (revenue officials also) and of the Collector and his Assistants, unchecked by the superior Government. But in an adjoining taluka, even an Assistant Collector with a true appreciation of the value of forests had no difficulty in preserving them.

I am glad to see that, at last, officious Forest Settlement Officers, with whom I have had trouble in this respect, have been clearly informed that their duties are confined to settling the legal aspects of the case. Being all Revenue officers in disguise, more or less antagonistic to forests, there was an inveterate tendency to gain popularity for themselves at our expense.

I do not quite agree, though the difference is perhaps one of terms only, that working plans, settlements and grazing should be arranged from the *general*, and not the *professional*, standpoint.

Public opinion is no doubt a great thing, so is any other brute force, if only it is big enough. But I hold that these matters should be fixed, sanctioned, and legally bound fast so as to secure their respective full shares to each term of the State,

present and future; and that then, and only then, the convenience of the people, the popularity of Government, of its officers, and such like matters, should be studied and given effect to by *temporary and revocable orders* emanating from the Forest Department. I object utterly to the present custom of the grant of privileges by Government Resolution. In most cases the people have asked for these privileges from revenue officials of all grades, who have expressed their sympathy. When the resolution comes out, we are made to appear as dire oppressors, only kept in order by the vigilance of a beneficent Revenue Department. When any privileges are granted by Government, it should be done by orders through the Conservator to the District Officer, who would publish and give effect to them. Petitioners to Government should merely be informed that the Conservator had orders to grant feasible requests, and would no doubt do his best for them. Any claims to *rights* would of course be shortly referred to the Settlement Resolution.

With regard to the pretty fiction of the Forest officer being an "Assistant to the Collector for forest affairs," I look upon it as a farce, which must be abolished, and the sooner the better. I cannot produce the evidence, but have a strong impression that the plan was invented by Dr. Brandis confessedly as the only means of preserving the infant Department from being incontinently butchered by its jealous uncle. There is no imaginable necessity for such connexion, and the practical inconveniences are grave. Delay of business, waste of paper, stamps, time and pay of Karkuns, the friction due to many wheels, the incompetence and vanity of a few, a very few, Collectors, though they would not admit it, &c., &c., last, but not least, the ignorance in forest matters of the junior Under Secretary. Of course the Collector could claim assistance in the management of any forests that might not be in charge of the department. Personally, I do not approve of the existence of "unreserved forests," whatever the term may mean in different places, and look upon it as a mere salve to conscience I would have all forests reserved, State, if possible, otherwise village. If they are not forest at all, but grazing grounds, they should not concern us, but the Revenue officers.

With regard to pay, the Inspector General should be a Secretary to the Government of India, paid as such, and Conservators should be paid at the same rate as Collectors.

Notwithstanding the depressing fact that a certain Great One, whose departure was a greater success than his administration, did not see fit to belaud our Department, I will venture the suggestion that, now all Departments are in imminent danger of being swamped, it is time the dazzling title of C.S. was either abolished or enlarged to comprise all *specially trained European* officers of all services.

"JOB."

A HIGH FOREST OF *QUERCUS DILATATA*.

THE following rough experiments and notes were made in an oak forest near Murree, and may be of interest in view of the fact that the forest closely resembles similar growths in Europe, and that such are believed to be—in the Punjab Himalaya at least—few and far between.

The area forms a compact piece of forest in one of the tracts recently reserved under the Rawalpindi Forest Settlement, and is traversed by the Kashmir road five miles beyond Murree. The forest consists of a regular high growth of oak (*Q. dilatata*), the trees being of an average height of 100 feet with a girth of 6 feet.* An undergrowth of suppressed oak poles and seedlings, with yew and broad-leaved trees, among which the bird-cherry, maple and horse-chestnut predominate, covers the soil, which is also plentifully carpeted with maiden-hair and other ferns. The underwood is entirely dominated by the large oaks which form the upper canopy, with their rather ill-grown crowns touching one another almost uninterruptedly. The girth of the oaks ranges up to 12 feet at breast-height, and the stems as a rule, are tall, straight and clean, with the lowest branches at from 60 to 80 feet from the soil.

The result of a rough valuation survey gave on an area of 56·5 acres, the following stock of oak, young trees less than 3 inches in diameter, and individuals of other species being neglected.

Diameter between :—

3″—6″	6″—12″	12″—18″	18″—24″	24″
263	421	462	519	892

This gives a total of 2,557 trees, or about 45 per acre. Of those above 2 feet in diameter, a considerable percentage was of very large dimensions, and this would probably account for the average girth of the whole, taken with the automatic tree-measurer being found equal to 6 feet 6 inches.

Time did not admit of systematic experiments and observations being made, but in order to arrive at some idea regarding the annual production in cubic feet, a tree of this girth, 102 feet total height, and growing in average conditions, was felled, and carefully measured up in imaginary billets. The age, from the rings, was taken at 125 years, and the real volumes of the bole and crown, proved to be respectively 105·6 and 7·8 cubic feet. The bole was taken at 66 feet in length, the first branch occurring at this height. As showing the small tendency of these stems to taper in, it may be mentioned that from this and

* Considering the large demand for staves for casks for the Hill Breweries, it would be well if experiments were made to decide on the suitability of *Quercus dilatata* for the purpose. Such experiments are already in progress in Jaunsár.—[ED.]

other specimens, it appeared that the girth decreased by only 0·5 inch for every running foot in length up to 50 feet.

Assuming that the average oak in the forest cubed 100 feet, with a corresponding age of 125 years (and this latter figure is fairly justified, the fertility of the soil which is of great depth and richness being considered), the following figures are obtained:—

		Cubic feet.
Total standing stock (oak),	...	2,55,700
„ average annual yield,	...	2045·6
Average annual yield per acre,	...	36·2

The latter figure should evidently be increased by the average yearly increment of the young oak and the inferior dominated species, although this quantity would probably be represented by a small figure only. Again, the area has never been worked and is practically a virgin forest, so that the opportunities which thinnings would have afforded to the oak to develop laterally, and to otherwise increase the mean annual production, have been entirely wanting.

In view of these considerations, and also because the quantity 36·2 cubic feet is believed to equal if not exceed the average annual production in high forests of similar species in Europe, and in which improvement fellings have not been carried out, this figure might well be called in question. It is however, believed to be within the mark; and the writer has certainly never hitherto, seen an oak forest of similar age in which the growing stock as regards number approached that in question, and especially in which the trees were of such uniformly active growth and good condition.

It would be interesting to ascertain the origin and history of this uninjured piece of forest, surrounded as it is by younger growth and different species, and by villagers moreover, who appear almost to take a wanton pleasure in hacking, lopping or otherwise damaging any tree-growth in their path. The inhabitants are Muhammadans, who relate merely that they were forbidden in the Sikh times and previously to injure the forest; but it appears probable that, at some earlier period, the area was preserved and used, as is so often the case in the hills, as a sacred grove.

VAGRANT.

MISUSE OF A STANDARD BOOK.

In the "Indian Engineer" of 8th January last, there is reprinted from the "Revue Coloniale Internationale" an "Extract from Report of Commander V. Lovett Cameron, R.N., C.B., on the Colonial and Indian Exhibition, South Kensington." The reprint is headed "Note on the Timbers of India," and appearing as it does in a professional periodical, one might ex-

pect it to be of some use to an Engineer. But as a glance showed it to be full of mistakes, whether of the "Reporter" or the printer, I have taken the trouble to go through it and note them, for the amusement of your readers.

First of all, however, I would inquire how came the sailor and distinguished traveller whose report is made use of to report on the "Colinderies"? He is surely not an authority on things in general, and he is certainly not an authority on Indian timbers, for, with the exception of a statement that piles of anjan (*Hardwickia binata*) that have been standing twenty years in water show no signs of deterioration, the only information he gives about any of the timbers mentioned in his "report" is simply cribbed in an abbreviated form from Gamble's Manual, or perhaps copied from the labels on the specimens exhibited. Probably, therefore, the "report" is merely that of the gallant officer in the capacity of a special correspondent of the "Revue Coloniale Internationale," a print that I have not come across, and the importance of which therefore I cannot estimate.

Taking the mistakes and misprints in the order in which they occur, I find, first, "siss" mentioned as one of the woods of which the ornamental archway at the entrance to the Economic Court is composed.

An attempt is made to give the botanical names of the trees which yield the timbers, but the author's name is never given, and in every case the specific name is printed with a capital initial, though only 8, I think, of the 31 in the list should be so printed.

The weight of *Acacia arabica*, Willd., is given as only 45 lbs. per cubic foot, whereas the average weight should be 54 lbs.

Alstonia scholaris, R. Br., is printed "Alatonia Scholari."

Anthocephalus Cadamba, Bth. and Hk. f., is printed "Antho cephalous cadaruba."

"The wood of the Jack fruit tree is said to be exported to Europe for brush "tacks," instead of "backs."

The vernacular name for *Bassia latifolia*, Willd., is printed *Makua.*

The *toon* tree is said to grow to a height of 60 feet in Burma and Assam. Gamble says 80 to 100 is common. Capt. Cameron correctly quotes Gamble as saying that this timber resists the attacks of white ants; but I doubt if this is strictly true, for while I was serving at Akyab, the whole of the seat frames in the Church there had to be renewed, and my recollection is that they were of toon wood, and that they were so eaten up by white ants that I could push my fingers through them.

Chloroxylon Swietenia, D.C., is printed "Chloroxylon Swietana."

Hardwickia binata, Roxb., is printed "H. Benata."

Heritiera littoralis, Dryand, is printed "H. Litoralis," and it is said to grow quickly on "ided" lands, instead of "tidal."

Juglans regia, Linn., is printed "Junghans Regia."
Lagerstrœmia Flos-Reginæ, Retz., is printed "L. Flos-Regina."
Machilus odoratissima, Nees., is printed "M. Oderatissima."
Melanorrhœa usitata, Wall., is printed "Melanorrhia Usitana.
Ougeinia dalbergioides, Benth., is printed "Ongenia, Dabelgioides."

A table exhibited is said to be made out of a "crop" section of *padouk*, instead of out of a "cross" section.

Sál is said to be a large "jugarious" tree instead of a "gregarious" tree, and the weight of the timber is given as 53 to 70 lbs. instead of 54-55 lbs. per foot.

The weight of *Terminalia tomentosa*, W. and A., is given as 71 ℔s. per cubic foot, whereas 59 ℔s. is the average weight of 13 specimens, including only one so heavy as 71 ℔s.

Xylia dolabriformis, Benth., is said to be found in South India and Burma, and the important forests of that tree in the Central Provinces are not mentioned.

On the whole, while there seems no reason why this "Note on the Timbers of India," which is merely a meagre compilation from Mr. Gamble's book, should be paraded in the "Indian Engineer" because it has so distinguished a name at the head of it, I think that the printer and editor are to blame for most of the ridiculous blunders it contains.

C. W. Hope.

FIRES IN FORESTS.

With reference to "Q's" note, on page 28 of the "Indian Forester" for January 1887, it seems to me a little difficult to compare the effects of an occasional fire in a forest successfully protected for some years with the effects of annual fires. In the case of annual fires, all that there is to burn is the year's growth of grass with the leaves and branches that may have fallen during the year, and a few fallen trees. The soil, owing to its being charred regularly and to no humus forming, is always poor and deteriorates slowly but surely. But a fire sweeping through such forests is, as a rule, of short duration, though fierce, and does not, I think, cause so much damage to standing trees that have risen above the grass as it would where there is an accumulation of decaying wood and much undergrowth which yield to the action of fire and carry it up to a greater height with longer continued influence. In such places, too, fires smoulder for a long time at the roots of large trees and work greater harm. I am told, on good authority, that some years ago a fire broke out at Kegda, in the Beiraghar Reserve, and burnt over 75 acres that had been successfully protected for about seven years. The evil effects on young poles and on older trees was very great, and remained evident for years afterwards.

The only way in which one might understand the Inspector General's remark is by saying that in a forest which has been successfully protected for years the grass will in parts have been entirely killed off, and the undergrowth may be so fresh and green and vigorous that fire, on reaching such places, will die out. But other portions will have been burnt, the slowly formed and valuable humus will have been destroyed, unburnt parts will have lost the shelter they had hitherto enjoyed, the labour, time, and growth of years will have disappeared, and the officers in charge are disheartened. Inasmuch as what has been destroyed was so much more valuable than the property on land annually burnt over, I cannot but disagree with the Inspector General, and hold that the effects of fire in a protected forest are intrinsically more disastrous than in an unprotected forest. *A fire in a forest is a public enemy.* It is infinitely worse than even *over-grazing.* Nature, with a kindly hand, may do her best to cover over the wound, but the evil has been done, the constitution of young trees has been rudely shaken, the soil robbed of its nourishing properties for years, affords but little food for either old or young trees; and to say or do anything which would lead subordinates or others to think that an occasional fire is a thing which, after all, may be, possibly, not so *very* harmful is much to be regretted.

G. J. v S.

January 1887.

NOTE.—The point our correspondent "Q" wished to press was, whether the protection of a forest from fire is worth undertaking, if there is much danger of an occasional fire, and whether the harmful effects of such fires counterbalance the good results of several years of successful protection. Our experience in sal forests leads to the view that the strength acquired in the roots of saplings during several years of protection, enables them to produce very strong stool shoots even when killed to the ground by a bad fire. These would never spring up in an annually burned forest. This restorative effort of nature is much enhanced, if stems injured by fires are cut back to the ground. Other larger trees also get their crowns beyond the reach of fire, or become protected by the thick bark, and thus, for both these reasons, the damage done by an occasional fire is diminished. In the case of chir, which can hardly be said to coppice, though something very like it occurs in burned saplings, the taller plants gradually get beyond the reach of a fire, the bark of saplings being very thick and corky, and every year during which the forest escapes, is a distinct gain.—[ED.]

SHIKAR.

THE following account of a man-eating tiger may be of interest, and may give some information. This tiger was an old male, and worked his wicked will on the human beings frequenting a certain ghat forest within a radius of some 10 miles, and had his own way of it more or less for a period of about three years. The District authorities took every means to circumvent him; large rewards were offered; the best local shikarries were enlisted and employed for months, and to encourage and give

them some status, a few picked Police Constables accompanied them, but they failed to bring stripes to book. On one occasion this band of braves came on the tiger having his noon-day siesta—they all went forward in a body and fired a volley, but the only effect it had was to make him run away. I do not know how many human lives this tiger had accounted for, but one village elder told me he had sat over 22 human "garas" without getting an opportunity of firing off his gun, and others tell the story of their fighting him with their axes and having hair breadth escapes. Two horses belonging to an officer who was marching through these parts were let go during a scare; with difficulty and by offering a good reward he got a dozen men to go in search of them; they returned without the steeds, but minus one of their number, whom the tiger had seized. This same officer then hit upon the novel idea of having a large bamboo cage built on a cart, sufficient to hold himself and two others, and on a smaller cart he had a 'mummy' erected. He then with the others in the cage, and having the mummy cart attached close behind, drove through this forest, and *shouted* for the tiger as they went along; the bait took, for presently stripes was to be seen only five paces distant worrying away at the mummy, and evidently thinking there was something inside beneath the clothes; however, what with the jumping of the bullocks, &c., the bullet missed its mark. After this several local shikarries tried their luck, and fixed their guns on to a human gara—this nearly succeeded, and the tiger went off with a broken leg, they followed him, but this only resulted in one of their number being killed. At last our sporting Chaplain tried his luck, and had a buffalo "gara" tied, this was killed, and he sat over it. Most men, even natives, would have succumbed to sleep by mid-night or sooner, but this veteran believed in his luck, and kept patiently on the alert, and towards the small hours of the morning the two hyenas which were having a repast rushed from off the gara, and then stripes glided into view quietly and stealthily—the murderer that he was—and got his quietus; he was covered with scars and wounds received from many an axe fight with the Gonds.

February 1887. C. P.

SNEEZEWOOD.

Mr. Hutchins writes from King Williamstown, Cape Colony, as follows:—This is a bad year for sneezewood seed, but I send you a little of what I have, being anxious to hear of sneezewood growing in India.* As far as I can remember,

* The sneezewood seed has been sent to Ranikhet, Chakráta and to the Punjab, and some boxwood seed will be sent from Jaunsár to Mr. Hutchins.—[Ed.]

you have no thoroughly durable wood in India, wood that you can put into the ground like a stone, and take up after 30 years with no signs of decay. Of course, in the ground, teak cannot hold a candle to jarrah and sneezewood. And since sneezewood grows on the mountains of Eastern Africa, a long way up into the tropics, where there are regular summer rains as in India, I do not see what is to prevent the acclimatization of sneezewood on the other side of the Indian Ocean. We are planting a good deal of jarrah in our plantations. The seed is more easily procured, though we have to send to Australia for it, and jarrah grows quicker than sneezewood. But in India, where you cannot grow jarrah, you might as well try sneezewood.

Forest work in this part of the Colony has taken a new start, with the employment of convict labour in tree-planting. Free labour is at exorbitant prices, 1*s.* 6*d.* a day for coloured men, and 3*s.* for unskilled white men. But sheep stealing is such a common crime that the prisons are always populous centres, and now the sheep stealers are planting trees! I expect that we shall soon have 200 convicts at work planting the upper slopes of the Amatola mountains. The indigenous forest is like the Shola forest of the Nilgiris on a large scale; and exotics thrive on the grassy slopes above and around the indigenous forest, as the Australian trees thrive on the Nilgiris.

I should be grateful if you could procure me a little good boxwood seed from the Himalayas.

D. E. HUTCHINS.

IV. Notes, Queries and Extracts.

Rab.—The Government of Bombay has published a most interesting report by the Director of Agriculture on experiments with *rab*, which is, both literally and metaphorically, the burning question of the day in the agricultural districts on and near the Ghats. *Rab*, as all the world now knows, is a term applied to the several systems in vogue in this presidency for preparing, and usually also burning, manure. It is a term also applied to the finished product. Mr. Ozanne distinguishes three kinds, namely, (1) cowdung, (2) *ain*, and (3) *fangal*. The first consists of layers of cowdung, straw, grass, earth and pit manure; the second of freshly-cut *ain*-loppings, coarse grass, straw, earth and pit manure (*ain* being the vernacular name of a common jungle-tree—*Terminalia tomentosa*): *fangal* is a shrub (*Pogostemum purpuricaulis*); and the third kind of *rab* consists of layers of freshly-cut *fangal*, grass, straw, earth and pit-manure; this last ingredient consisting of the contents of the dust-bin with some cowdung added. Small plots of land were manured with these three kinds of *rab* at Lanauli, Khadkala, Igatpuri, Karjat and Alibag. At each of these places the results were largely in favour of cowdung-*rab* as regards the yield of cereals; then came *ain;* and last of all *fangal.*

Mr. Ozanne is inclined to value *rab* more for its efficiency in killing weeds and noxious insects than for its manurial properties, but, in our opinion, his experiments tend if anything to show that the mineral constituents of the loppings are the most potent factors in the success of the crop; only in this manner can we explain the superiority of freshly-cut to dry jungle-*rab*, which is apparently due to the fact that, as soon as the green parts of a tree begin to fade, the most important mineral constituents, with which the leaves are, so to speak, saturated during the period of vegetative activity, flow back in large quantities to the stem, there to remain stored up until the next season. It is, however, very difficult to make comparisons or draw safe conclusions, from these experiments, as they vary greatly in regard to the quantities and kinds of material used, as well as the conditions under which they were made; besides this, it is not always quite clear what description of material was used, and the areas experimented on were too small to admit of reliable inferences. Nobody is more alive to the deficiencies of these first trials than Mr. Ozanne himself, who warns his readers repeat-

edly that it is impossible to draw any final conclusions from them; but, subject to this proviso, he considers that, until the contrary is proved, we may conclude that :—

"(1). The manner in which the ryot utilizes the materials at his disposal is the most economical and the most remunerative. Hence, all attempts to teach him to use manure, or leaves and grass, or the like, in a way different to that in which he uses them, are extremely hazardous and require the utmost caution.

"(2). Rice can be grown without *rab*. The ingenuity of the ryot has discovered substitutes. But I think it is proved that all substitutes are either more costly or more risky than the approved methods.

"(3). Though rice can be grown without *rab*, yet *rab* greatly increases the yield, and, therefore, the food supply of the country. The yield now suffices to support a largely increased population with, I believe, a considerable margin for export. If, however, diminished by prohibitions against, or scarcity of, *rab*, it is a question whether this margin would not more than disappear.

"(4). If the full value of the materials used for *rab* is charged in the cost of cultivation, rice cannot be grown with profit. Even without this charge the margin of profit in a good year, such as that during which the experiments were carried on, is not large. It has to cover the charges on account of true rent, from which must come the assessment both on rice-land and whatever area is appended to rice-land for the growth of *rab* material."

These generalizations, as already observed, are admitted to be hastily arrived at, and should be accepted with caution. There can be no doubt that the first conclusion is wrong; it is going too far to assert that the ryot's disposal of the materials at his command is the most economical, when, as a matter of fact, it is well known to be the most wasteful, as we shall be able to prove further on. Again, we can find nothing in the report which proves that *all* substitutes for wood-*rab* are either more costly or more risky than the approved methods.

To show how far from closed Mr. Ozanne himself considers his *rab*-question; how anxious he is not to mislead; and with what serious misgiving he regards the future of the ryot dependent on *rab*, it will suffice to quote the concluding paragraph of his report :—

"'I trust that these deductions' (those just quoted) 'are sound. They are, at any rate, made from the unbiassed opinion formed after most careful study of the subject. But I am very far from thinking that I have mastered the subject. I have already begun arrangements for continued experiment. My conviction is that the only way to decide how far in the interests of forests, and in those of the people themselves more especially, the drain on the lands which produce the *rab* materials, whether in or out of the forest, can be prevented from causing exhaustion—a point which has been nearly reached in Igatpuri, Khadkala and Lanauli—is to go on with the experiments now begun, to show precisely the position of the ryot and what it is tend-

ing to become, and thus to make it possible for Government to restrain him from inprovidence when it is clear such restraint is necessary.' "

As in most other matters concerning forest economy in this country, we may profitably turn to the experience gained in countries more advanced in scientific methods than India, which have gone through, or are still experiencing a phase of agricultural development similar to that which we are now witnessing out here. It does not seem to be generally known, but it is, nevertheless, a fact full of interest to the Indian farmer and his master, that *rab* and *kumri*—the two great evils which threaten to utterly exterminate the hill forests of this presidency—have been extensively practised in Germany, and that *rab* still is rampant in some States, although everywhere steps are being taken to stop it on Government land, because it has been found to be incompatible with the maintenance of the forests. No wonder, then, that, with numerous State-supported laboratories, kept solely for the promotion of forest and agricultural research, German experimental physiologists should have worked out, and be able to explain, scientifically, the effect of *rab* both on the forest, from which it has been taken, and the cereal to which it supplies nutriment.

It is not possible in the short space of an article to go fully into this wide subject, but we may at all events give briefly some important facts which have been established by numerous carefully-conducted experiments.

All trees consist mainly of certain volatile substances—oxygen, hydrogen, nitrogen and carbon—which are called their organic constituents, in contradistinction to the so-called inorganic elements, which are not volatile. It is with the latter that we are chiefly concerned in this enquiry, because, although all trees consist of over nine-tenths of organic elements, they are dissipated in the *rab* process by burning, and it is only the residue, or ash, that is available for direct use as a fertilizing material. Of these constituents about 45 per cent. are carbon, which is assimilated only by the leaves in the form of carbonic acid, which is always contained in small quantities in the atmosphere, and about 48 per cent. consists of oxygen and hydrogen, which are taken up by the roots of plants in the form of water and in other ways. The loss of these three elements in burning *rab* is consequently of minor importance, but nitrogen, which is taken up solely by the roots, is irretrievably lost in the air and more difficult to replace.

The essential inorganic, or mineral, constituents, amounting to about 5 per cent. of the whole tree, consist of potash, soda, lime, magnesia, ferric oxide (iron), manganic peroxide, phosphoric acid, sulphuric acid, silica and chlorine, which are here given in the combinations with organic elements in which they are usually found in the plant. All these substances are taken up exclusively by the roots, and are absolutely necessary for

plant-growth. They are very unevenly distributed in the tree and wander about, according to the season, in the direction in which they are most required by the plant. Consequently, green parts, notably the leaves when green, which alone elaborate the sap that builds up the tissues of plants, contain a large quantity, the bark and young shoots less, and the stem least of all. During the period of active vegetation (in these latitudes, therefore, chiefly during the monsoon) the quantity of organic and inorganic nutriment in the leaves and young shoots reaches its maximum, the former consisting chiefly of starch and sugar, and the latter of phosphoric acid and potash. But when the leaves begin to fade, the quantity of these substances diminishes, and the fallen, or dying, leaf does not contain nearly as much of the most useful nutriment as the healthy green leaf, nor does a dead, or dying, branch contain as much as a healthy one. Schröder found, for example, that the ash of healthy leaves of Scots' pine contained 40 per cent. of potash and 19 per cent. of phosphoric acid ; while the ash of dead leaves of the same tree contained 9·5 per cent. of potash and 4 per cent. of phosphoric acid. These two substances are quite the most important mineral constituents necessary for vegetable life, and it is certainly a wonderful provision of nature that they should return to the stem just before the fall of the leaf, there to remain stored up for future use. Viewed by the light of Schröder's experiments, which have been verified by others, it is easy to understand why Rambux insists on cutting his *rab*-fuel when vegetative functions are in full swing. It matters nothing to him that he thereby arrests the growth and threatens the very existence of the goose that lays the golden eggs ; he thinks the forest will last his time at all events, and regards the man, who ventures to suggest the propriety of providing for future generations, as hopelessly idiotic.

One of the most important questions which the Forest Commission now sitting at Poona will have to decide, in spite of Rambux's supineness, is whether the forests can stand the drain to which they are now subjected or not, and Mr. Ozanne has rightly drawn our attention to this part of the subject which is of such vital importance to the *rab*-cultivator. If, as at present constituted, they cannot stand the drain, and if further provision cannot be made to extend the loppings over a larger area, so as to make the effect less disastrous, the situation will be a very awkward one. In that case, if things are allowed to slide in the present happy-go-lucky manner, the final collapse may be postponed indefinitely, but it must surely come, and the last condition of the farmer will be at least as bad as if steps had been taken to grapple with the evil now. On the other hand, if Government decide that *rab* must be stopped or curtailed in Government land, there will be a general howl of indignation from cultivators—who possibly may, with justice, claim a right to

rab—egged on by a crowd of professional agitators and others not interested in the maintenance of the forests. What hope, then, is there that Government may escape this dilemma? If we turn to the facts elicited by German experimentalists, the prospects of the farmer dependent on *rab* are not encouraging, no matter whether the practice be put an end to by Government interference or not. As everybody knows, the soil of an un-rabed forest is yearly enriched by débris of branches and leaves which, in decaying, supply a quantity of organic and inorganic nutriment to the forest. If this litter be removed from a hectare (2½ acres) fully stocked with beech-trees, the soil loses annually, on an average, according to Ebermayer's experiments, 3,147 kilogrammes of organic and 185 kilos. of inorganic fertilizing matter (a kilogramme being equivalent to 2·2 lbs. Avoirdupois). In forests which are rabed when green, the loss is greater, because green foliage contains more useful mineral nutriment than dead litter; nothing, of course, is done to replace this large quantity of natural manure.

Setting aside deterioration from physical causes, which is very great in forests whose soil is deprived of its natural covering of dead leaves and twigs, we might almost conclude from Ebermayer's experiments that the exhaustion of soils under *rab* could only be a question of time. All farmers know well enough that even the best soils are soon exhausted when they are steadily deprived of large quantities of nutriment, and no manure is substituted to repair the loss; but, if this is the case with agricultural soils, it must, *à fortiori*, be the same with forest soils, which are generally much poorer than cultivated land. Stöckhardt has submitted the matter to a thoroughly practical test by examining two plots of ground, side by side, both stocked with Scot's pine 50 years old, of which one had for some time been deprived periodically of its dead litter, and the other had not been interfered with in any way. The ground was examined to a depth of 20 inches, and the results were as follows:—

The untouched area contained 19,950 kilos. per hectare of mineral nutriment soluble in muriatic acid, and 4,720 kilos. of mineral nutriment soluble in water. The rabed area contained 14,950 kilos. of mineral nutriment soluble in the acid, and 2,865 soluble in water. A very decided deterioration had, therefore, taken place in the supply of mineral nourishment, but the loss of organic nutriment was naturally still more marked. The protected area was found to contain 139,670 kilos. of organic matter to the hectare, and, of this quantity, the nitrogen weighed 8,354 kilos. In the rabed plot, the organic matter amounted to 60,438 kilos. to the hectare, the nitrogen weighing 4,759 kilos. The difference in favour of the un-rabed plot was, therefore, 79,232 kilos. of organic matter. The reader can easily draw his own conclusions from these experiments in regard to the fate

which is in store for rabed forests which are not of vast extent relatively to the area they manure.

Customary usage in Government forests, which in spite of all legal maxims to the contrary, may easily amount to a prescriptive right in the eye of the practical legislator, may necessitate the continuance of abuses, but an abuse which involves the ruin of a valuable State property may perhaps be tolerated, but certainly should not be allowed to spread: the immediate interests of a few must give way to the lasting interests of the many, and, if the evil cannot be eradicated, its growth may at least be arrested. Systematic experiments would in time show whether the area available for *rab* is sufficient to admit of the practice being perpetuated, or if it must sooner or later come to an end: in the meantime, having no actual facts to go upon, excepting those obtained in foreign countries, we have no means of forming a decisive opinion.

Apart from considerations of rights of usage, it appears doubtful if the game is really worth the candle. Even to the farmer, supposing him willing and able to employ his labour in other ways, the advantages are perhaps less than one may easily be led to suppose. Mr. Ozanne, who certainly takes a most unbiassed view of things, but who, as Director of Agriculture, cannot fail to be more interested in the welfare of the ryot than in that of the forests, frankly confesses that, on the evidence collected by himself, *rab* does not pay. It is only by ignoring the wages of the farmer and his family, and the sale value of the *rab*, that a profit is made out. Surely there must be something radically wrong in a system of agriculture, which cannot be made to pay its own way. The amount of labour which the farmer must bring to bear on the *rab* system must be very great in proportion to the effect. Wolff, for instance, calculates that 330 hundred-weight of dry spray and leaves of oak, or beech, would yield one hundred-weight of potash and phosphoric acid, but that the collection and carting to destination of this quantity of *rab* would alone cost more than the value of the same quantity of artificial manure; of course, this statement is probably not applicable to Indian conditions, but it shows that enquiry in this direction would not be without interest.

To show to what extent forest trees are able to supply the mineral nutriment requisite for agricultural plants, we may quote the results of some experiments. The most important mineral compounds of plants are potash, lime, phosphoric acid and silica. According to Ebermayer, a hectare, cropped with the following species, requires these substances in the following average quantities per annum for each species :—

1. *Potash.*		1. *Potash.*	
Potatoes,	... 120 kilos.	Fodder-grass,	... 78 kilos.
Clover,	... 102 ,,	Peas, ...	... 48 ,,

1. *Potash.*

Wheat, ...	... 29	kilos.
Beech, ...	... 15	„
Spruce, ...	... 9	„
Pine, ...	... 7	„

2. *Lime.*

Potatoes,	... 37
Clover, ...	... 112
Fodder-grass,	... 49
Peas, ...	... 47
Wheat, ...	... 9
Beech, ...	... 96
Spruce, ...	... 70
Pine, ...	... 29

3. *Phosphoric Acid.*

Potatoes,	... 36
Clover, ...	... 31
Fodder-grass,	... 24
Peas, ...	... 21
Wheat, ...	... 21
Beech, ...	... 13
Spruce, ...	... 8
Pine, ...	... 5

4. *Silica.*

Potatoes, ...	... 8
Clover, ...	... 8
Fodder-grass,	... 80
Peas, ...	... 9
Wheat, ...	... 97
Beech, ...	... 63
Spruce, ...	... 58
Pine, ...	... 7

According to this statement, it would require about three acres of well-stocked beech forest at its best (*i.e.*, before deterioration by *rab* had set in) to provide sufficient mineral nutriment for one acre of wheat; beech, be it noted, being a tree which yields, relatively to most other species, a large quantity of nutriment, and only grows in comparatively good soils.

It would require comparative experiments on Indian forests and cereals, similar to those we have referred to, to enable us to say roughly what quantity of forest of any given description is, on an average, capable of fertilizing an acre of land under given conditions, and to what extent *rab* affects the growth of forests. It is hopeless to expect to arrive at any satisfactory conclusion until these data are worked out, for, although the results obtained in Germany may be considered sufficiently clear and conclusive for that country, it is not likely that people out here will admit that what has been found true for a far off land must necessarily be true for India.

Another matter, to which, no doubt, the Agricultural Department will direct its attention, is a means of more economically exploiting the rabed areas. We have seen what an enormous *loss of organic nutriment is occasioned by burning the produce*; possibly some method might be devised, by which only a small portion should be burnt and the rest utilized in the natural way.—*Times of India.*

CLIMATE OF MANIPUR.—In connection with Major Macgregor's paper on his journey from Upper Assam to the Irrawadi, read at a recent meeting of the Royal Geographical Society, and printed in the new number of the Proceedings, Dr. G. Watt made some valuable remarks on his own observations in the Manipur district. Manipur is a small valley surrounded by mountain ranges, and in this valley the rainfall was found to be only about 39 inches,

but seventeen miles off, in the mountains which formed the north-east ranges, the rainfall was as much as 120 inches, and towards the Naga country to the north it became greater and greater in certain limited tracts. In the Khasia Hills 600 inches might fall in one place, and twenty miles off only 50 inches. Nothing in Manipur struck Dr. Watt so much, as a botanist, as the remarkable transitions of vegetation in that small region. Dr. Watt gathered twelve or more species of oaks, many of which were new to science, and ten or twelve species of rhododendrons, in Manipur alone. The *Rhododendron Falconeri*, found in the Naga Hills by Sir Joseph Hooker, is nowhere met with in the immense tract between the Naga Hills and Sikkim. This and the epiphytic *R. Dalhousiæ*, which grows on a hill thirty miles north of Darjeeling, Dr. Watt found in the Naga Hills at an altitude of 6,000 to 8,000 feet, and these rhododendrons never occur in Sikkim below 10,000 to 13,000 feet. There were many instances of plants falling in their altitude as the traveller passed to the east and south-east from Sikkim, until at Moulmein a rhododendron was found growing near the sea, a circumstance which was not met with in any other part of Asia. There is something in that region which, apart from pure geography, is of vital interest. Sarameti, which is under 13,000 feet high, the natives said, had snow all the year round, whereas on the Himalayas the lowest point at which snow occurs is 17,000 feet. In Manipur, the whole valley, 3,000 feet high, was covered with hoar-frost in December. Dr. Watt thought this was a point that should be thoroughly investigated : what is the cause of this falling in altitude in the vegetation? General Strachey, who was in the chair, considered that the peculiarities of the vegetation of Manipur compared with Assam were connected with the evident lowering of temperature indicated by the low snow-line. There could be no doubt that the warm currents of air coming up the valleys of the Irrawadi and the Salween and meeting the snowy mountains to the north produced an enormous precipitation of rain, which during winter fell as snow. The consequence seemed to be that there was snow there at a very much lower level than in the mountains further to the north. That an immense quantity of rain fell in the upper portions of the valley of the Irrawadi there could be no question. Such a rainfall seemed in itself quite sufficient to account for the large volume of water that was drained off by the lower portions of the Irrawadi ; and anybody who knew what Tibet was, General Strachey stated, must be aware that, even with a course of several hundred miles the river would pick up but a small quantity of water in comparison with the enormous volumes which were collected from the rain which fell in Upper Burma. General Strachey had roughly calculated that a monthly fall of rain of 18 inches over a square degree would mean 65,000 cubic feet per second for the whole month.—*Nature*.

ARBORICULTURE ON THE SULEIMAN RANGE.—The following letter from the Rev. Dr. Jukes, Medical Missionary, Dera Ghazi Khan, will be read with interest :—

"I have just had a conversation with Colonel Thompson about arboriculture, about which I am interested, as I am a yearly visitor at Fort Munro on the Suleiman range, and he advised me to write to you on the subject, and if you can give me any suggestions and help me with seeds or plants to try experimentally, I shall be greatly obliged. The elevation is 6,400 feet, with a rainfall averaging 10 or 12 inches ; the soil, when not alluvial in the small valleys, is generally, after removing the surface stones, a stiff clay, and, owing to the dry atmosphere, we have difficulty in finding suitable trees. Plums, apricots and peaches do well, and olives, figs and willows grow in the nallas, but we find it very difficult to grow any forest trees. The cypress does well, but oaks, casuarinas, *Grevillia robusta*, carob, tún, sirissa, holly, have all done badly. Mulberry is the only imported forest tree that has done well, the shisham is indigenous, but stunted, hardly exceeding 20 feet where it grows best. Deodar and allied species have been tried, but in four years have hardly made 6 inches in growth, though in sheltered situations they grow better. Eucalyptus, I do not know the species, grows to 30 feet in sheltered places, but even there suffers from the cold in winter, and on the hill top is cut down almost to the ground.

"Several stunted species of acacia are indigenous, but only attain to the size of bushes. I have been told that trees found on the arid slopes of the Himalayas would probably do well, but I do not know what they are.

"The cold is very intense in winter, and in summer, although the temperature in the shade does not go much above 90° (it varies from 55° to 87° in the verandah), it seems to shrink up the plants from its dryness. If you could help me in the matter, I shall feel greatly obliged. Mr. L. Dames, the Deputy Commissioner, brought some seed of the Mexican forage tree, a species of acacia, one of which I have and that is doing well. He would second all my efforts by raising trees in the gardens about 1,000 feet below Fort Munro. I propose sending a man up in February to plant, and should be thankful for suggestions with or without seeds or plants."

Some *Pinus Sinensis* seed was sent to Dr. Jukes, and *Cryptomeria Japonica* and others will be sent for trial.—*Proceedings, Agri-Horticultural Society of India.*

INDIA-RUBBER.—(From Messrs. Lewis and Peat's Report.)—The total receipts in England of all kinds of rubber in 1886 have been nearly 8 per cent. above those during 1885, but we exported of these a larger proportion than usual to America,

Our own consumption of Para has been very moderate. America continues to largely increase her consumption. Deliveries there (of Para) during 1886 we estimate at 8,000 tons against 7,500 tons in 1885, 5,500 tons in 1884, and 4,900 tons in 1883. The shipments from Para were (shipping weights, and including Peruvian), 13,060 tons in 1886, 12,500 tons in 1885, 11,400 tons in 1884, and 9,800 tons in 1883. The loss in weight in passage this season has increased, and averaged nearly 9 per cent. America received from England nearly 1,000 tons Para last year. Her large purchases here early in the year caused an advance from our opening (January, 1886) quotations of 2*s.* 7*d.* for fine, and 1*s.* 11*d.* for Negro-head. The large shipments to New York in the spring stimulated the market, and we gradually advanced. In July the quotations were 3*s.* 2*d.*, and by September 3*s.* 6*d.* for fine, and 2*s* 8*d.* for Negro-head. This was the highest of the year, and we steadily declined to 2*s.* 11*d.* and 2*s.* 2*d.* in November, but recovered 1*d.* per lb. at the close. Of rubber besides Para our imports are largely increased, and deliveries also, but a great portion for re-exportation; and our own trade has been quiet, though steady. All kinds of good medium rubber have sold very readily at relatively high prices throughout 1886. We received of Assam and East India 301 tons against 270 tons; Borneo, 312 tons against 404 tons; Zanzibar and Mozambique, 1,066 tons (200 tons in transit) against 672 tons; Madagascar, 69 tons against 88 tons; West India and Central America, 111 tons against 181 tons; Africa, 2,318 tons against 1,404 tons; Ceara and Mangabeira 135 tons against 72 tons; sundries, chiefly Peruvian, 193 tons against 220 tons. This year has begun with active demand and few sellers. About 65 tons fine sold from 3*s.* 1*d.* to 3*s.* 2½*d.*; Negro-head, 2*s.* 3½*d.* to 2*s.* 4½*d.*, closing firm.—*Times.*

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THE SYSTEM OF FOREST MANAGEMENT IN SWITZERLAND.

State of the Forests of Switzerland prior to the revision of the Forest Laws.—It is usual to recognise the system of forest management as exercised in Switzerland as the most perfect known in our day. But with this recognition, which is, we grant, perfectly justifiable, must come the consideration that it *has been, as we shall presently see,* the result of the most pressing necessity. It may, indeed, be bluntly stated as a general axiom, that the last matter which engages the earnest attention of the administration of any country, is the management of its forests. So long as the requirements of the country are satisfied, either by cutting from its own resources, or by importation from without, the healthy state of the forests themselves is not regarded. Or to put it financially; so long as the interest comes in regularly, no one cares to enquire into the security of the capital. The disappearance or precarious state of this comes by way of a startling surprise on the Government of the day, who express, with virtuous indignation, their surprise at the supineness of their predecessors. In no country were the effects of this supineness more clearly shown than in Switzerland. But, fortunately for her, in no country were the powers of conservation and reproduction,—the conservation of what remained, and the reproduction of material to supply the former waste,—more readily at command and more easily brought again under control.

Speaking roughly, 19 per cent. of the total area of Switzerland is under wood, and again speaking roughly, three-fourths of this amount of woodland, belong either directly to the State, or to the Communes who are under State control. With all these resources at command, the regulations formerly in force had so fallen into disuse, that the official reports* of 1858-59 stated that the actual production of the forests was not sufficient for the necessities of the inhabitants, without taking into

* Report of 1858-59-60, by E. Landolt to the Federal Council.

account those of the industries of the country, or of the means of transport. A later report* stated the case with more urgency, if in fewer words, thus—the consumption exceeds the production by 12,089,200 cubic feet, and the importation exceeds the exportation by 14,823,000 cubic feet. The Switzerland of 1863, in short, spent 6 millions more than it obtained for exported wood, on importing wood for its requirements. From the outcome of such continued management, the report proceeded to forecast "certain ruin," and the result was the reorganisation of the Forest Administration as it now exists. While, therefore, it is true to say, as is so often insisted, that forestry has been practised as a science in Switzerland for hundreds of years,—a merit also claimed with more or less reason, by other European countries,—it is equally true to say that the present system of forest management is an infant of only some five and twenty years of age. With these preliminary remarks, we shall proceed to trace the steps by which this infant has attained to a vigorous manhood.

Nature and extent of the Swiss Forests.—*1. Private Forests.* Three-fourths of the area under wood in Switzerland are, we have said, under direct State control, the remaining one-fourth being the property of private individuals. But, under the exigencies of the state of matters which had been brought to light in the reports we have mentioned, private interests had to yield to the public good, even the proprietors were restrained from the selfish and inconsiderate use of their forests. They were prevented, in fact, from wasting their capital, to the detriment of others as well as of themselves. They could not, for example, cut down the trees on lands which were unfit for any other product, than that of wood. They could not fell the forests which were situated on steep slopes, the denudation of which would expose the neighbouring lands to destruction by avalanches or by floods. And the penalties for transgressing these rules were sufficiently deterrent, *viz.*, a fine of a franc for each square perch of land so laid bare, besides the obligation to place the land again under wood within not less than two years. Speaking generally, moreover, all operations in the woods, belonging to private individuals, required the sanction and supervision of the State Inspectors.

2. *State and Communal Forests.*—While these recuperative and restrictive measures were taken in private forests, strict regulations for the working of the State and Communal forests were peremptorily laid down, and rigorously enforced. Before going further, it may be well to have a distinct idea of what are meant by Communal forests.

We have seen that even private proprietors were not the absolute masters of their forests, or the sole judges of the way in

* Report to the Federal Council on the Forests of the Alps and the Jura.

which they should be managed. In a far stricter sense, was this the case as regards the forests nominally under charge of the Communes. These were, in fact, only the stewards, not the possessors, of their property. The regulations laid down for the management of the State forests, were in equal force in those belonging to the Communes, and the special duty of the State Inspectors with regard to the Communal forests, was to see that these rules were carried out, their particular care being, that in the annual fellings the "possibility" of the forests was not exceeded. This limit of "possibility" was annually fixed, and the trees to be felled, carefully marked, so that no plea of ignorance could possibly be urged. In short, all operations were conducted by the Communal authorities under the advice and direct surveillance of the State. Without such supervision the temptation to recoup the losses occasioned to the Communal treasury, in consequence of a succession of bad harvests for instance, by the felling of an undue proportion of wood, may easily be imagined. Our readers will thus understand that, what follows may be taken as applicable to both State and Communal forests alike.

General Principles of Forest management.—After the formation of a special department and the careful selection of the "personnel" of that department, there are three outstanding principles, which must govern the successful carrying out of the systematic management of the forests of any country.

These are *first*, the careful mapping out and distinguishing by recognised boundaries the reserved or State forests ; *second*, the constitution of a "close time" for the cutting of wood and its removal from the forests ; and *third*, the regulation of the rights or privileges of pasturage.

We shall now proceed to examine how these principles were insisted on, in the forest system of Switzerland.

1*st*. *The Demarcation of Forests*, as to the demarcation which must manifestly precede the other two. The marking out of the boundaries of the various forests, State, Communal and private, was no capricious or sudden act of an irresponsible department. It was rather a solemn function, of which due notice was given in the Official Gazette, made by a sworn "Commissary Surveyor" in the presence of a delegation of the Municipality, the Forest Inspector and the neighbouring proprietors. All rights were thus represented, and all reasonable objections were entertained and disposed of with as brief delay as possible, under the provisions of the Rural Code. The boundaries once fixed and recognised were carefully gone over at intervals not exceeding four years, in the presence of those interested, and exact and detailed plans of the various forests were prepared and kept in duplicate, one copy being deposited in the State Archives, the other being at hand for "field" use.

2nd. A close time for Forest operations.—The second principle, *i.e.*, the establishment of a "close time" for forest operations was laid down with equal exactness. No felling or working of wood of any sort, was permitted in the forests of the plains between the 1st of May and the 30th of September, or in the forests of the mountains, between the 1st of June and the 31st of August. A decree of the Council of State determined the forests which were included in either of these categories. An exception, however, was made in the case of oaks intended to be barked, which could always be felled in the month of May. The purchasers of wood sold either felled or standing, were not permitted to commence their work without the official ratification of the sale, and their authorised entry into the forests, no work whatsoever being permitted on Sundays, on days of religious or civil Feasts, or at night.

3rd. Regulation of the rights of Pasturage.—The third great principle, which we have laid down, is the regulation of the rights of pasturage. Here we have one of the most difficult, as it is one of the most important, matters of forest management. The rights of pasturage are not easily controlled, and cannot be entirely extinguished in any country without great abuse of power, and without inflicting hardship on the people. Those who know the tenacity with which all rights of commons are clung to in our own country, will possibly be surprised at the uncompromising nature of the provisions which regulated the exercise of this right; or to speak more correctly, this privilege, as it was considered in Switzerland. Not, however, that these provisions were any less strict than the exigencies of the case demanded. All those who have had anything to do with the rearing of trees, know how absolutely incompatible with the existence of plantations, is the admission of cattle. Recognising this incompatibility, the first general rule laid down was that, no animals of any sort were permitted in the plantations, or in any woods, where the trees were less than 15 feet in height. These parts of the forests were absolutely closed against pasturage.

Secondly, pasturage was not allowed in the Cantonal forests at all, or in one-fourth of the Communal forests of older growth than those above-mentioned. In the other three-fourths of the Communal forests, cattle were admitted from the 13th of May to the 31st of October, in the plains, and from the 25th of May to the 9th of October, in the mountains. Sheep and goats were not admitted to the forests of the plains at all, except in places where the soil was so rocky, as not to be capable of bearing anything but brushwood. The number of these animals, which each family was permitted to send to such pasturages, was fixed by the Municipality, who had to advise the Forest Inspector of the district of these permissions. If the demands were in excess of the areas, which could be opened to grazing, preference

was to be given to the poorest households. Independently of the above restrictions, the Council of State reserved to itself the right, absolutely to interdict for as long a period as seemed good to them, the exercise of any rights of pasturage at all, if the state of the forests of any Commune, appeared to demand entire rest.

General Laws and their enforcement.—The laws regarding the marking, cutting and floating of timber, the laws regarding its public sale by auction, the laws imposing fines on trespassers, &c., do not differ in any material respect from the general forest laws which are found to be necessary in all wood-producing countries, where timber is valuable. These need not be specially gone into here, except to note that the members of a Municipality or Commune were held individually responsible for any violations of the laws, and were personally punishable by fines for these, and fines always carried with them, besides their money value, the obligation to restore within a fixed time, woods destroyed or damaged by neglect, as well as by wilful mischief. The fines themselves, when they were incurred for contraventions of the laws in the Cantonal or private forests, were given to the Cantonal hospital. When the violations of the law were committed in the Communal forests, one-third was given to the Cantonal hospital, and the remaining two-thirds went into the Communal treasury.

Rights of "Usage."—There remains only to be noticed as a speciality of the system of forest management in Switzerland, the exercise of the rights of usage and their compulsory surrender or purchase for a sum fixed in proportion to their yearly value. These rights of usage, such as pasturage, turbage, &c., unless they were founded on titles, were at once suppressed. If they were founded on titles or otherwise justified by their possessors, they were declared purchasable by the payment of a sum equal to twenty times the mean value of the right, during the preceding 20 years. The working of this provision, which sounds strange to our English ideas, will be better illustrated by the following case taken from the official reports of one of the Cantons.

The Cantonal Tribunal, in its meeting of——has pronounced the purchase by the State of the right of usage affecting the forest of——in favour of Monsieur A. B. in granting him an indemnity of——francs or the choice of a piece of ground representing this sum. Monsieur A. B. having appealed to the Federal Council, the definite settlement of the matter is again deferred. In the report for the following year, we read a summary solution of the difficulty, under the provisions above alluded to. The Federal Council, having declared itself incapable of judging the appeal made to it by Monsieur A. B. concerning his right of usage in the Forest of——, the Cantonal Tribunal has proceeded definitely to settle the matter as follows :—Monsieur A. B. having volun-

tarily and formally refused from the State both the ground, and the sum of money allotted to him by legal judgment, *his right has ceased to exist.*

On properties where these rights of usage were intermingled, as for instance, on mountain holdings, where the forest appertained to one person, and the pasturage to another, the two interests could be divided at the request of one or other of the parties interested. In this way, the proprietor of the pasturage, would obtain a portion of the forest for his domestic uses, besides the isolated trees to serve as shelter for his cattle, while the proprietor of the wood, retained the surplus, and acquired a right of pasturage. If the parties could not agree over this interchange, arbitrators were appointed at the public expense. Here, the arrangements were very elaborate, and we may perhaps be allowed to detail them, as illustrative of the working of a Communal Government.

In the first instance, five arbitrators were appointed by the Tribunal, and their nomination notified to the judge of the place. Each of the interested parties was at liberty to challenge one of these five arbitrators, so that their number was eventually reduced to three. These having taken the prescribed oath, investigated first the titles, and then the lands in dispute. They thereon made an estimate of the annual value of the right, and determined the portion of the forest, which should be assigned in compensation for its surrender. Any appeal from the decision of the arbitrators was carried to the Cantonal Tribunal.

The general rights of usage to wood for the construction of new buildings, or the repair of existing ones, were exercised only under the special authorization of the Department of Agriculture and Commerce in Cantonal forests, or of the Municipality in Communal forests. In each case, however, the resumption of the right was reserved.

General observations.—We hope that we have made it sufficiently clear, that while all the above measures had in them a ring of autocratic, or, if our readers prefer it, democratic power, which would most certainly be resented in our own country, yet that the provisions made were so just in themselves, and so manifestly for the public good, and the good moreover of the Municipality or individual interested, that they provoked no resistance, and were acquiesced in with more or less heartiness. Indeed, it is one of the most pleasing features of the Swiss management of forests, to the contemplation of which we are led as it were by insensible, but still tolerably apparent steps, that the people of all classes are fully aware of the benefits resulting to the governed as well as to the Governors from the systematic management of their forests. True, it may be said, that arguing from the state of matters that existed previous to the strict enforcement of the laws, common sense would dictate a general acquiescence; but then we do not look, unless we are

of an unusually confiding disposition, for the display of common sense from nations, any more than from individuals. It is, we repeat, a pleasing feature of the system to observe, what is repeatedly recognised in successive forest reports, the hearty co-operation of the people, with the Inspectors of the forests.

We have written purposely in the past tense of the system as it was introduced or rather re-established after the consideration of the reports to which we have above alluded. The regulations, as they were then made, are still in force, and govern the principles of forest administration. Practically, however, as their beneficial results became apparent, it has been found possible and advisable to relax in some degree the provisions which are more individually repressive, such, for instance, as that restraining the liberty of action of private forest proprietors. The resumption, however, of each or all of them, in their entirety, at any time that may become necessary, is readily allowable by the existing authorities. It is equally allowable, therefore, for our readers, to read present for past in the foregoing observations.

Statement of Revenue, Expenditure, &c.—The success of the system may be gathered from the following tables, which may be taken as representative ones, representative that is, in respect of the years reviewed, which do not embrace either expenses or receipts of an unusual nature, representative also as being those of a Canton which is under vigorous forest administration. It must be noted, moreover, that while the financial results as detailed, have been achieved, the extent of the forests has not only been maintained, but has been increased, and all fellings carefully made good by replanting, while the interests have been accruing, the actual capital has been nursed and consolidated.

STATEMENT A.—CANTONAL FORESTS.

Receipts.

Heads.	1884.	1885.
	Francs.	Francs.
Sale of wood for the public service, ...	358,496	318,694
Wood given to usagers, ...	3,100	2,503
Sale of forest plants, ...	6,735	7,151
Sales of hay, &c., ...	7,042	7,592
Floating, ...	78	831
Casual receipts, ...	589	733
Francs, ...	376,040	337,504

Expenditure.

Heads.	1884.	1885.
	Francs.	Francs.
Establishment, ...	49,548	51,920
Laying out and extension of new forests,...	3,702	8,293
Plans and enclosures, ...	1,003	278
Plantations and nurseries, ...	15,945	21,955
Felling and transport, ...	44,695	43,899
Official notices, ...	1,607	1,214
Maintenance, &c., of roads, ...	51,805	17,002
Floating of timber, ...	791	829
Maintenance of domains, ...	1,669	1,399
Payments to "usagers,"	*22,362*	*24,100*
Value of wood to usagers, ...	3,100	2,503
Provision for receivers, ...	6,952	6,138
Extraordinary expenditure, ...	16,851	23,382
Francs, ...	220,030	197,911

Reducing this, for convenience' sake, to pounds sterling, we find that, in 1884, the receipts were £15,040 and the expenses £8,800, leaving a net surplus in favour of the forests of £6,240.

In 1885, the receipts were £13,582, and the expenses £7,917, leaving a net surplus in favour of the forests of £5,595.

We will not trouble our readers with a mass of figures relating to the operations conducted by the Communes. The forests in their charge naturally suffered most severely under the neglect of former years, and the restoration of the equilibrium between supply and demand has been thus less easily handled. The condensed statements (*a*), (*b*), and (*c*), given below, will show the manner in which this was set about, and the extent to which it has succeeded.

Statement B.—Communal Forests.

(*a*). *Sowing and planting.*—In the year 1884, 990 kilos.* of seed were sown, and 2,025,800 young trees planted. In the year 1885, 530 kilos. of seed were sown and 1,976,960 young trees planted. These operations embraced an area of 104,735 acres, and were undertaken in view of the prospective requirements for timber and fuel.

* Kilo. = 2·204 lbs. English, say, 2 lbs. 2 oz.

(*b*). *Felling of forest trees for timber.*—In the year 1884, 119,913 cubic feet of timber were felled, the "possibility" however being stated at 115,102. In the year 1885, 114,999 cubic feet of timber were felled, the "possibility" being put at 114,743. The felling therefore was in excess of the proper ratio, but in a lessening degree.

(*c*). *Felling of smaller trees for firewood.*—Here, as we might expect, the equilibrium was more easily restored, and the consequent conditions of the fuel reserves very healthy. In the year 1884, 11,800 arcs* of firewood were cut, the possibility being placed at 14,532 arcs. In the year 1885, 11,059 arcs were cut, the possibility being placed at 14,623 arcs. The supply was thus officially stated to be in excess of the demand.

STATEMENT C.—PRIVATE FORESTS.

In the year 1884, 304,880 plants were sold to private proprietors from the Government nurseries for the purpose of re-afforestation. In the year 1885, the number of plants sold was 264,195. This brief statement illustrates the manner in which the State encouraged the extension of private enterprise, *viz.*, by the sale of seed and plants at a price considerably below their market value.

A TOUR IN THE SALT RANGE.

WHEN exploring for coal in 1885, I discovered a bed of fossils which caused surprise because the fossils (chiefly species of *Conularia*) were pronounced by the Geological Survey to be of carboniferous age, and yet the strata in which the bed occurred had hitherto been considered as cretaceous.

It was thought that an examination of the rocks further west might yield the required information. This expectation was amply realized. I found pebbles with the same fossils in crystalline boulder beds at a new place (Nila Van) underneath the speckled sandstone. (See A. B. Wynne, Memoirs of the Geological Survey of India, Vol. XIV., 1878, page 90, No. 5). The speckled sandstone underlies carboniferous limestone, and it follows with certainty that the crystalline boulder bed, in which the pebbles with carboniferous fossils occur, is all one and the same and of carboniferous age, as argued by Dr. Waagen in the records of the Geological Survey of 1886.

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* Arc = 100 square metres, the metre being equal to about 3 feet 3¼ inches = 3·281 English feet.

I extended my journey to Varcha, about 63 miles from the Mayo Salt Mines, and found the crystalline boulder bed just the same as eastwards. The character of the boulders is the same, and some of them show glaciation.

As I had before this found several crystalline boulders and pebbles in the Eastern Salt Range, not only simply ice scratched, but faceted on all sides by the agency of moving ice, there is no doubt that the whole crystalline boulder bed in the Salt Range is derived from a carboniferous glacial period.

This is a fact of importance in its bearing on the Indian coal measures generally. It has also been argued by Dr. Waagen, the Palæontologist, that the glacial crystalline boulder beds of the Salt Range are very likely of one period with the similar beds in the Talchirs, which underlie the true Indian coal measures. With regard to the Salt Range, his suppositions were proved correct; as regards the Talchirs of the Indian coal measures, proof is still wanting.

The Salt Range extends from east to west a distance of 125 miles, across the Sind-Sagar Doáb between the rivers Jhelum and Indus. It rises to 2,000, 3,000, and in one case to 5,000 feet above the sea. It derives its name from the extensive deposits of rock salt. In addition to the rock salt, there is also coal. Compared with the salt, the quantity of coal is very small still, a workable area has been found, and a colliery has been established (Dandot). The Salt Range is of great importance geologically, and highly instructive.

Salt of an older palæozoic period forms the base, and above it follow palæozoic glacial beds, carboniferous limestone, mesozoic strata, then the coal with a variety of tertiaries. The whole series of sedimentary strata is thus represented, and the number of fossils is very great.

The coal of the Salt Range has nothing to do with the true Indian coal measures of the carboniferous period.

The carboniferous rocks of the Salt Range are principally of marine origin. Only traces of coal occur in them, and never any real seams. The coal of the Salt Range underlies the eocene (nummulitic) limestone. About 500 square miles of the limestone form the plateau of the Range, and in several places good coal is found cropping out underneath.

In some instances, the excavations showed the coal unfit or too thin for profitable working, but the exploration, in 1886, disclosed a sufficiently extensive portion of thicker seam under the small plateau of Dandot. On this, the Dandot colliery has been established.

The field is an approximate square with sides of two miles length. Along the whole south side, the coal has been proved continuous 3 feet thick. On the west side, it thinned out to 10 inches, and towards the centre, a bore hole proved 18 inches of coal at 340 feet depth. On the east, 5 feet thickness of good

coal were proved about a mile away from the Dandot plateau, and lately, one new drift disclosed the coal 3 feet thick, on the eastern edge of the Dandot plateau itself. Some other drifts on the south scarp were continued in the coal several 100 feet underneath the plateau, and apart from structural irregularities, the coal has kept on well, and improved in quality with the progress into the interior.

A supply of one million tons has been estimated in the plateau, and what progress there has been in excavation corroborates this estimate, as a safe one.

A main low level entrance has now been started, and the mining is to begin in earnest, after the colliery has been completely connected with the line of railway. A branch line on the broad gauge about three miles long will be completed in a few months from Keorah (Mayo Mines) Station, to the foot of the Dandot hills. From the foot of the hills, to the colliery, a tramway is under construction with steep inclines, on which the descending loaded trucks pull up the empty ones by means of wire ropes. Including this tramway, the total length of the connection with the Keorah Station will be about 5 miles. The removal of the coal will thus become very easy.

The excavation of the coal beneath about 400 feet of superincumbent limestone and alluvium will be a more difficult task. It is to be hoped that when the full working takes place, the loss of life through the breaking down of the roof may be prevented. A liberal expenditure on supports and on filling material from the outside is advisable.

At the time of my visit, the actual outturn of coal was only 300 tons a month. It is of course expected to rise much higher after the opening of the whole Sind-Sagar Railway and the completion of the bridge across the Jhelum river at Chak Nizám.

The Forest Department receives a royalty of 4 annas for every ton of coal raised.

The Railway is at present the only consumer of coal, but a demand for coal may arise for other purposes.

That the coal-bearing strata extend over a very much larger area is known on geological grounds. The question is, how far the seam continues thick enough for working. Chittidand, near Dandot colliery, was found to have a thick seam, but the area over which the full thickness kept on, was not sufficient.

Other places showed the seam only 8 to 12 inches thick, but one (Tid) on the other hand has 5 feet. I have little doubt that places exist under the main plateau with areas of thick workable seam as extensive as the Dandot working area, but it would require careful and thorough exploration to find out such sites, and none could at present be more conveniently situated for railway communication than Dandot. A large salt mine (Mayo Salt Mines) and a colliery for the railway

being both situated on a branch of only 10 miles length is very favorable.

I visited also a seam of bituminous shale in the Nila Van, 25 miles due west of the Mayo Salt Mines. The seam occurs in the gypsum which rests on the rock salt. The seam is 6 inches thick, not enough to repay excavation. The shale burns with a long smoking flame, and would no doubt yield a large proportion of oil by distillation. Traces of such shale were also noticed near the Mayo Salt Mines, and on a former occasion I distilled some oil from it (A. B. Wynne's Memoir on the Salt Range, page 75, footnote). The following is the analysis of some of the shale made at Dehra Dún :—

Bituminous shale from the gypsum above the rock salt at Nila Van in the Salt Range—

Ashes, ...	62
Fixed carbon, ...	13
Oil, ...	13
Water and gases, ...	12
Total, ...	100

Specific gravity of the shale = 1·3.

The ashes are white.

It is well to draw attention to this shale. A thicker deposit might exist: if not in the gypsum above the rock salt, there might be more below the rock salt.

The rock salt is the lowest known rock of the Salt Range, and no strata underlying the rock salt have as yet been ascertained *in situ*, nor have any sinkings or borings been made to find out what is below the salt.

The beds of gypsum overlying the salt form one continuous band nearly along the whole Salt Range, and the salt itself may also be nearly continuous. At the Mayo Salt Mines, no less than 600 feet thickness of saline rock are known, and about half of the thickness is pure salt fit for human consumption. At other places, the salt is thinner, sometimes only 10 or 20 feet of pure salt being visible. In the absence of excavation, no general estimate can be made, but so much is certain that the supply of rock salt in the Salt Range is literally inexhaustible.

A large amount of salt is actually exposed on the surface, particularly inside of the deep gorges, which cut through the high southern escarpment of the Salt Range. On the right bank of the Indus, near Kálabágh, there is enough good salt exposed for the supply, by mere surface quarrying, of 1,00,000 maunds a year to the Government Salt depôt there (1 maund = 82⅞ lbs. English). The larger quantity, about 12,00,000 maunds a year, which is issued at the Mayo Salt Mines could not be conveniently obtained by quarrying, and seams from 50 to 150 feet thickness are worked underground. The seams are inclined, and the excavation proceeds in regular parallel chambers 45 feet

wide, 100 or 200 feet high, and limited by the width of the respective seams. Pillars or walls of rock salt 25 feet thick intervene between the chambers and bear the weight of the hill, which is about 400 feet high. This system is in force since 1872, and a considerable underground space has resulted. There is one chamber 200 feet high, 200 feet long, 45 feet wide, which just represents the whole output of one year, so much salt having been eaten by 15 million people in a year.

The mine is provided with a tramway, 2½ feet gauge, which is working since 1873. The tramway leads from the interior of the mine to the Kheorah Station of the Sind-Sagar line one mile from the mouth of the mine. The cost of production is less than one anna per maund, so that the imposed duty of Rs. 2 per maund is almost entirely clear revenue to Government. Any amount of salt might be removed unlawfully from the natural salt outcrops, and sold at a very profitable rate, if precautions were not taken. There is a large establishment under the North Indian Salt Revenue Department, and about 500 of the men with their officers (Superintendents North Indian Salt Revenue) are occupied in guarding the natural salt outcrops of the Salt Range. A practise exists of surrounding these outcrops with fences of branches and thorns as a protection against intruders, and of late very great energy has been shown by the Department in this respect. Officers try to get as much fencing work as possible done by their men, and thus, the extensive salt outcrops in their charge are surrounded by double or triple fences of branches. The branches are hacked off the nearest struggling shrubs and small trees, chiefly the thorny *Acacia modesta*, and it may be imagined how much material is required for many miles of outcrop, and how much damage can be done by several hundred men thus let loose upon ground, where a much needed scanty growth of shrubs and trees is struggling to maintain itself on steep rocky slopes in a hot climate with, at the most, 16 inches of rainfall.

The worst is that the fences once made do not remain. A great many of them are eaten by white ants or washed away by sudden floods, and have to be renewed from year to year. It is a pity to see so much injury thus done to the trees, on a hill area which has very great need of vegetation.

Not only is the material procured in a most reckless and destructive manner, but I can affirm that the whole object is a mistake. One might as well think of keeping thieves from off a treasure chest by placing thorns round it, as of keeping salt smugglers from the salt outcrops by means of these fences. Thieves can always make a way to the outcrop by removing the thorns, and the establishment then put the thorns back again. As a check on the watchfulness of the establishment the fences are thus no good either.

The surface of the outcrops themselves is the only real check

against undetected theft. The area of the outcrops should be kept free from loose and projecting pieces, so that any removal of salt can be traced afterwards by the injury done to the surface. If mechanical means are desired to keep the thieves off the salt, there are many other more appropriate means than the thorn fences. Old mines can be closed; craters filled, old salt heaps removed, areas rendered inaccessible by cutting away pathways, and in special cases walls can be constructed. All this is far more permanent and useful work, and not injurious, as is the destruction of the trees on the steep slopes and sides of the gorges.

The abolition of these thorn fences round the salt outcrops, mines, &c., in the salt gorges is a most desirable step. Without this abolition, all the endeavours to improve the growth of vegetation in the salt gorges and their neighbourhood are useless.

The Salt Range generally is in a frightful state, as regards the protection of the hill-sides by trees. To give an idea of the comparative barrenness of the area, I made a rough estimate of the quantity of fuel available, if every existing tree and shrub in the whole place would be cut down to the roots.

I estimated the amount thus supplied—

(1), in the forests protected against grazing since 15 years or so.

(2), in the protected forests, in which grazing continues, including the salt gorges.

(3), in the villagers' own waste lands.

			Fuel per acre.
In No. 1,	...	...	200 maunds.
In No. 2,	...	...	20 „
In No. 3,	...	...	2 „

These figures are not intended to be accurate. They are mere approximations, in the place of still more vague verbal descriptions.

In many places near villages, there is literally nothing left but a scanty growth of grass between the stones and rocks, unless the very soil even is gone and the bare clean rock exposed.

Some flats and depressions on the plateau and sides of the Salt Range are filled with alluvial soil and serve for cultivation. Some fields obtain an irregular supply of water from the surrounding hill-sides. The larger areas are grazing grounds, which would be so much the better for a growth of trees.

There is excessive wind blowing all over the Salt Range. It is no doubt largely due to the absence of tree vegetation. Wind-mills for raising water and grinding corn would be very suitable at many places on the plateau, but none exist. If only one wind-mill could be erected as a pattern, others would follow suit.

In comparison with the injurious climatic effect of several hundred square miles of bare surface in the Salt Range hills

and neighbourhood, the damage done by the occasional torrents in the great gorges of the Salt Range is inconsiderable. They carry sand and salt out into the plains to the south between the Salt Range and the river Jhelum. If the flow would be more regular it could be used with more benefit for the fields, and some measures could also be adopted to diminish the absorption *of salt by the rain water from the outcrops.*

The Salt Department is really in a position to render most valuable service in the protection of the forest grounds all over the gorges where their guard-posts are. Five hundred men stationed over the forest area could easily afford absolute protection to the tree growth. If the Salt officers could be interested in the matter, a most efficient aid would result.

One of the officers of the Salt Department (or more correctly North Indian Salt Revenue Department) told me that he intends to apply for permission to attend the theoretical course of *the Dehra Dún Imperial Forest School for one season. If this* be granted to him, others would very likely follow. A course of natural science would be of benefit to all those officers of the Salt Department who have charge of mines, salt lakes or salt manufactures. They might attend for three months, and obtain leave for the purpose just as if they had the usual language leave.

H. WARTH.

EARLY DAYS IN ASSAM.

My first experience of the large game of Assam dates from a very remote period. I was then about 6 or 7 years old, and my father was Surgeon of an Irregular Corps, called the Second Assam Sebundies, commanded by Major P. Mainwaring. The head quarters of the Regiment was at Rangagora, a military station in Upper Assam, which was abandoned many years ago, and the site is now a thriving tea garden. The Regiment itself ceased to exist about the time of the abandonment of the Cantonment, but at the time of which I am writing, Rangagora was a busy little Military Cantonment, newly established and requiring a great deal of jungle clearing and house building to make it inhabitable. There were immense wastes in all directions, teeming with game of every description. My experience was, however, limited in the matter of sport to witnessing the shooting of a splendid wild buffalo, which came about in this way. The people of the country were utter savages, and the milking of cows was unknown. Buffaloe's milk was however procurable, and in order to obtain a permanent supply for a somewhat large family my father invested in four milch buffaloes. These animals were a great source of delight to my brother Tom, who was about four years older than myself. He became quite expert in riding and guiding them. They were magnificent beasts, much bigger than

the attenuated race of Bengal buffaloes, since introduced into the Province. They had fine horns, the smallest of which were not under 9 feet from tip to tip—dimensions almost unknown now among cow buffaloes in Assam, owing to the admixture of the puny Bengal and North-West species. To return, however, to our small herd at Rangagora, the beasts behaved remarkably well for some months. Milk was abundant in the household, and there was more butter than we could well consume, but everything is fleeting in this sub-lunary sphere, even the supply of buffalo milk, and one morning we were surprised and grieved to learn that our small herd of buffaloes had eloped, taking their calves with them. From enquiries made it was ascertained that they were last seen in the company of a stalwart bull buffalo, a good specimen of the genuine wild race. He had apparently persuaded our buffaloes to exchange their life of servitude for one of freedom. No one dared to interfere, as the cover was thick, and it was not devoid of danger to follow him and his new companions into the forests. We were thus reduced to a milk famine, as the villagers were unable, at a short notice, to supply us with any. Fortunately the buffalo keeper ascertained in a few days that the runaways were in the habit each afternoon of taking a siesta on the sands at a bend of the Debrú river, some few miles from the station, while they spent the remainder of their time in dense and unapproachable cover. Being satisfied of the correctness of the information, my father obtained the use of a dugout with two rowers. He carefully loaded a muzzle-loading 12-bore gun, and with a small supply of ammunition sallied forth to recover his property. My brother Tom accompanied him of right, but I had considerable difficulty in being allowed to join the party, though on promising to be very quiet, and sit well inside the dugout, I was permitted to enter it, and we rowed away on our expedition with the good wishes of all who saw us off from the ghât. The river was by no means a broad one, neither was it very deep throughout its course. At some points it was shallow enough for a man to wade across; on both sides there were dense forests and undergrowth relieved only at the bends by small spots of sand fringed by grass jungle. We rowed down silently for nearly an hour, the river being very tortuous. At length the herdsman who accompanied us whispered to my father that we were approaching the spot where the wild one and the runaways were in the habit of disporting themselves. My father at once saw to the caps on the nipples of his gun, and got ready for the emergency. Another turn of the river brought us full in view of the happy party. They were all lying on the warm sand thoroughly enjoying themselves. A slight noise made by one of the rowers at once aroused the vigilance of the wild bull, and he sprang to his feet and advanced towards the boat, which was then in a remarkably shallow part of the stream; my father covered him with

his gun, and as the brute showed signs of following us into the water, he fired and hit him about the right temple. The brute at once charged into the stream, which was not more than knee deep, and dashed at the boat, but as he approached my father fired again at close quarters into his shoulder, this quite sickened him, and he swerved from his charge, bounding across the stream in a few plunges instead of returning to his companions, who remained motionless all the time. My brother no sooner saw the wild buffalo on the opposite bank than he jumped into the river, and wading on to the sands to where the tame buffaloes were. He soon secured the principal one, and the herdsman securing another, the other two with all the calves followed, and we returned in triumph to cantonments.

The riders of the buffaloes finding a short cut by the river bank, next morning, my father sent a tracker to follow up the spoor of the wounded wild buffalo, and it was found dead within a few yards of the bank, the second bullet having gone very near his heart. His horns were magnificent, and long remained a family trophy. As a matter of course the milk famine to our great delight ceased at once.

My second direct acquaintance with the habits of big game was acquired about two years subsequent to the above narrative while I was still a lad. It impresses itself chiefly on my memory by reason of its being connected with two points which have been often discussed by sportsmen, and in regard to which divergent views are frequently held. The first of these disputed points is whether a tiger will break into a house to kill its prey, although it cannot see it, and the second is, whether the "phaiho" is an ordinary jackal, or a distinct species of animal. I think the story which I am about to relate, although it may be disappointing in having nothing exciting about it, will effectively set at rest the above two points.

We had left Rangagora on the disbandment of the Second Assam Sebundy Corps, and my father was posted as Civil Surgeon of Sibsagar, which at that time was rather jungly, although it is now a centre of civilization for tea gardens. All the civil buildings and residences of officials in those days were constructed on the banks of a very large tank about half-a-mile square.

The banks were formed no doubt with the earth taken from the tank when it was dug, supplemented by the excavations from a moat, which at a distance of some hundred yards ran on all four sides of the banks of the tank. My father owned a plot of land on the bank of this tank, which now forms the site of the circuit bungalow. He had built a rather comfortable bungalow with out-offices close by, and among these was a fowl-house, which also afforded accommodation for a milch cow. The walls of this building were of plaited reeds, well plastered with mud, and they were strengthened on the inside by bamboos

split in halves to keep out jackals. One evening about 9 or 10 P.M., while we were all gathered a round a wood fire in a large iron pan in the drawing room, the house not being provided with a chimney, we heard a continuous barking of dogs outside, intermingled with the shrill cries of the "phaiho." We were not unaccustomed to these noises, but on this night, they seemed much louder than usual. At length we heard a great commotion in the fowl-house as if the ducks, fowls and geese were all clamoring to be released. My father who was engaged reading at the time, turned to my brother Tom, and bade him take a lantern and go and see what occasioned the noise. My brother hastened to obey, but in a few minutes returned with a very scared face, and stated that as he attempted to open the door of the fowl-house, he was greeted by a terrific roar inside, and that the whole building shook as if it were about to fall on him. My father at once caused torches of thatching grass to be lighted, and we advanced to the fowl-house. On opening the door a ghastly sight awaited us, our favorite milch cow lay quite dead with blood gushing in torrents from its neck. It had of course been killed by a tiger, which we observed had effected an entrance by tearing away the reed walling and bamboo fence on one side of the house, and had effected its departure by bursting through them on another side, when it was disturbed by my brother, who fortunately had taken a lantern with him, the light of which no doubt frightened him away from the prey, which he had just killed.

It was not possible to do anything beyond hastily closing the huge aperture, which the tiger had made in the walls, by tying a few bamboos across them securely. We then shut the door, and betook ourselves back to the bungalow, feeling greatly relieved when we found ourselves in comparative safety inside, for although the walls were only of lath and plaster, we felt sure that he would not endeavour to enter so large a building, besides, as he was not apparently a man-eater, he would have no inducement. It has puzzled me since that he made no attempt to interfere with us while we were engaged in repairing temporarily the damage which he had done to the fowl-house walls. We noticed from his impressions on some soft ground next day, that he must have watched our operations from a bush about 40 or 50 yards off. During the whole time the "phaiho" kept up their monotonous and weird cries, and the dogs continued barking at a safe distance. I fancy the blaze from the torches of thatching grass must have kept the tiger off. For some hours after our return to the bungalow, and after we had retired for the night, the cries of the phaihos in the immediate neighbourhood of the bungalow were kept up, but to our great relief, they gradually withdrew to a distance towards morning, in the direction of a jungle beyond the moat which surrounded the banks of the tank.

As soon as daylight appeared we hastened to inspect the scene of the catastrophe, and found from his foot-prints that although the tiger had apparently been several times round the fowl-house after our visit to it, and had obliterated the foot-marks which our party had made in repairing damages, that he had been unable to muster sufficient determination to re-enter the building, although the body of his newly killed prey was inside, and he had had no time to eat any portion of it. I think the incident a remarkable one, as during my long and varied subsequent experience of the habits and customs of tigers, I have never known of a single instance in which they have broken into a substantially walled house, for the purpose of killing their prey. They have been frequently known to enter cow-sheds and take away one of the herd, but in all these instances there were either no walls to the sheds, or the walls were of bamboo rails through which the animals inside could be seen distinctly. I cannot also understand why he did not repeat his visit to the house to devour his prey. The natives affirmed that as tigers are very cautious he may have dreaded that a trap had been laid for him, when we visited the place and repaired the breach he had made.

On the following evening about 4 P.M. our servants raised a cry that the tiger was in sight, and to our intense astonishment we saw the huge brute walking leisurely along a road which skirts a moat extending all around the Sibsagar tank. He was certainly not more than 300 or 400 yards from where we stood in front of our bungalow. Two jackals followed him at a short distance, uttering at intervals the weird and piercing yell known as the cry of the phaiho. The tiger kept sauntering along quietly without noticing them apparently; at length he squatted in the middle of the road, and looked benignantly in our direction. We maintained a respectful quiet lest he should be irritated by being shouted at, in which case a few bounds would have enabled him to clear the moat and be amongst us. The only gun my father possessed was out of repair at the time, but even if it had been available, it would have been very risky to have attacked the brute on foot. I believe, however, his intentions were not hostile, as he appeared to be in good humour, and by no means bent on mischief. After a while he resumed his leisurely walk along the road. The phaihos still maintaining their shrieks, and following him at his own pace; at length he stopped suddenly and facing the jackals chased them for about 20 or 30 yards, beating out savagely with his fore paws once or twice, when he thought he had them within his reach, but they were far too nimble for him, and soon distanced him, when he again sat down on his haunches and glared angrily at the jackals, who now being quite safe continued to cry with greater rapidity than ever. The tiger remained in sight on the road till it was quite dusk, when we saw him enter a patch of grass bordering a paddy field, from which place it appears he sallied forth during

the night, and killed and ate a confiding pony which had come to graze on the paddy. He appears to have removed to some other locality after this exploit, as we neither heard nor saw anything more of him.

SENEX.

WALL-PICTURES TO ILLUSTRATE THE MINUTE STRUCTURE OF PLANTS.

Sir D. Brandis has presented a beautiful set of colored and shaded diagrams, illustrating the minute structure of plants, to the Forest School, Dehra Dún, and the following introduction to his description of them will interest our readers :—

Major F. Bailey, the Director of the Indian Forest School, some time ago suggested to me to send to Dehra Dún a collection of large-sized illustrations to be used in the Botanical teaching at the Forest School. This suggestion I discussed with Dr. Eduard Strasburger, the Professor of Botany in Bonn University, and he has kindly made a selection for me from the illustrations which he uses in his lectures, and has, moreover, superintended the copying of them. Some of the illustrations are taken from the published works of other authors; the majority, however, are enlarged copies of drawings made by Professor Strasburger himself, some published, some as yet unpublished. Ten plates have been taken entirely, and a few more partially, from the work "Wandtafeln für den Naturwissenschaftlichen Unterricht, Pflanzenkunde" by Kny.* In some of these, important corrections have been introduced.

The numerous discoveries made by Professor Strasburger in anatomical and physiological Botany, as well as his excellent work "Das Botanische Practicum," Jena, 1884, are probably known to Botanists in India. For the information of the students at Dehra Dún, I may add that he is now one of the leading authorities in this branch of Botanical Science. An English translation of an abridged edition of his "Botanisches Practicum" is expected to appear ere long.

While I am indebted to Professor Strasburger for the selection of the illustrations, I am alone responsible for the explanations. In framing these explanations in English, I have to a great extent used the terms employed in George Lincoln Goodall's "Physiological Botany" (second volume of Asa Gray's "Botanical Text-Book"), New York and Chicago, 1885, and in Bower and Scott's translation of A. de Bary's "Comparative Anatomy," Oxford, 1884.

The illustrations represent the more important points relating to the histology of phænogamous plants. The teacher should

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* Abbreviated in the notes.—Kny, Wandt.

consult several plates for the representation of one object. Thus he will find the protoplasm and cell-nucleus represented on plates 2, 3, 5, 6, 8, 11, 24 ; starch grains on plates 4, 5, 21 ; intercellular spaces on plates 1, 5, 22, 25, 26 ; and ducts on plates 9, 14 to 19, 21, 22, and 28.

To the list of plates I have added a few notes in order to draw attention to some important points. I have also given references to the best recent works upon the subjects illustrated by the plates. I could not have undertaken to enter into anything like a complete explanation of the plates. This would have assumed the shape of a book.

I have read with the greatest satisfaction the periodical accounts of the progress made in the Forest School, which have appeared in the "Indian Forester" and elsewhere, and I was pleased to see that, in the first year's theoretical instruction, Vegetable Physiology, including the structure of wood, occupies the first place. In undertaking the present work, my wish was to facilitate the teaching of this subject. The time allotted to the course of theoretical instruction at the Forest School is necessarily short, the science of anatomy and physiology of plants is exceedingly large, and the indefatigable researches of numerous workers in Germany, France, and Great Britain, as well as in other countries of Europe and America, are developing and enriching it steadily. Hence in organizing the teaching at an institution like the Forest School at Dehra Dún, the aim should be to make a good selection of subjects. Unless this is done in a methodical manner, no satisfactory results can be attained.

Hence, in the present work, I have confined myself almost entirely to phænogamous plants, and my sole aim has been to facilitate a good understanding by teachers and students of a few leading points. *First*, the different descriptions of cells and their arrangement in tissues—epidermis, parenchyma, and fibro-vascular bundles. *Secondly*, the arrangement of tissues in roots, stems and leaves. *Thirdly*, the chief organic substances which are necessary for the life of these plants.

I wish to seize this opportunity to state my opinion strongly that the students at the Forest School will not be able to grasp the leading facts of anatomy and physiology of plants without a good knowledge of some portions of Organic Chemistry and of Systematic Botany. Further, that Chemistry, in order to be fully understood, must be practised by the students in the Laboratory, and that the teaching of Systematic Botany must aim at giving them a good practical knowledge of the trees and shrubs of which the forests are composed. Here, again, a good selection of subjects is essential. Such a selection is practicable, and upon the greater or less skill with which this selection of essential points is made, the greater or less success of the teaching at Dehra Dún will depend.

The present work is restricted to a few of the most elementary and most important matters in regard to the anatomy of plants, and yet at every step almost we stumble upon questions not yet finally settled and matters not yet cleared up. In my notes I have been careful to draw attention to a few of these doubtful points. And yet the matters to which the present work relates have been the subject of research and experiment by a large number of eminent Botanists during the present century. In most cases, the plants of Europe with which these Botanists were perfectly familiar have furnished the material for these researches. New and unexpected discoveries are being made constantly at the present time. I have no greater wish in connection with this work than that the plates and the suggestions which I have thrown out in my notes may induce some of the professors and students at the Forest School, and Foresters in India generally, to commence independent researches on botanical questions with or without the microscope.

How much may be done to correct errors and to make discoveries, even in those matters which are believed to be firmly established, is shown by the excellent work done by some of my former colleagues in India, in order to determine with certainty the time required to ripen the seeds of the deodar and *Pinus longifolia*, and to correct the errors into which I had fallen when writing the "Forest Flora of North-West and Central India." The plates of the present work and my notes may contain many imperfections, and it will be a satisfaction to me to learn that an improved edition has been prepared by Indian Foresters. In an Indian edition, the material ought to be taken from Indian trees and plants.

To my mind, the most satisfactory feature in the Dehra Dún Forest School is that it has been established and is maintained for the Natives of India. Through the influence of this institution mainly, we must hope that Forestry in India will become naturalized, and will cease to be an exotic plant. When the organization of Forest Ranges has been completed, there will be more than 1,000, perhaps more than 1,500, Forest Rangers in all India, and the Forest School will thus exercise its influence on a large scale, and perhaps several such institutions will then be formed. The teaching of practical professions, which are based upon science, and which are connected with the land, like Agriculture and Forestry, is, I feel assured, destined to accomplish great things for the welfare of the people of India. Wall-pictures are often mounted upon cardboard to hang up. The arrangement adopted by me is, I believe, preferable in the present case. They are fastened with drawing-pins upon a blackboard, or wherever they may be wanted.

BONN, May 1886. — D. BRANDIS.

FOREST DENUDATION IN TIHRI GARHWAL.

My reason for wishing to "appear in print" is only because an outsider's version of the destruction of forests by irresponsible persons may have the effect of bringing the value of forest conservation more prominently before the public.

We (my brother and I) view with the greatest alarm the possibility of the resumption of the leased forests bordering on the Dún by the Tihri Raja, as we know how his hill forests have been destroyed near Mussoorie. To begin with the east of Mussoorie and Landour. During my time, the forests between Landour and Kowdia Gulla beyond Dhunoltie have been all cut—for what?—a few hundreds of rupees paid by potatoe cultivators. The trees were allowed to rot or burnt into charcoal at the immensely remunerative rate of Rs. 4 per kiln of 200 maunds, this being the amount of the royalty charged. I saw some of the gigantic trees rotting on either side of the road, in 1882, years after they had been cut to let the potatoes grow. What benefit did the Raja get? I do not think he can have been enriched by a total sum equal to what he would be getting now yearly, if the forests had been judiciously cut, and wood and charcoal supplied to Landour and Mussoorie. In the meantime, the forest has been destroyed—25 miles in length and 2 miles broad.

To the north of Mussoorie, along the Chakráta road, as far as Sainjí village, the only "scenery" left, where there was good forest, are ghastly lime kilns. To the west, Benóg, once a beautifully wooded hill, is denuded of almost every tree, and only saved from utter destruction by the Municipality discovering it was within Municipal limits. Now it is being preserved, but it will not be worth anything for many years. Beyond Benóg hill, and further west, the most beautiful oak forest I ever saw was in two years turned into charcoal, for I believe a total sum of Rs. 200, paid to the Raja's people. The ground on which this forest was, is gradually being cut up by landslips, where no

forest will of course grow again. Again, beyond Benóg and to the south-west on the Bhudráj Hill, the Raja's boundary is clearly marked, where Shib Rám's land ends and the Raja's begins, as clearly marked, as the western boundary of the Landour Cantonment. In both these cases, the forest ending marks the beginning of the Raja's territory, which is encumbered with grass only! I mentioned Shib Rám, he is a most enlightened native, and does a lot for preservation of forests.

As a result of this wholesale destruction, the hills are being cut up by landslips, and the price of wood and charcoal has doubled within the last five years, and is yearly rising. Some effort is really necessary, for the good of the station, to stop this destruction chiefly in the Raja's territory.

To show what can be done with ordinary trouble only, we may mention that we burn some 25,000 maunds of wood yearly from our own forests, and will burn 50,000 maunds soon without it being possible for any one to say we are doing any harm to the forest. In fact we are the only people who have any extent of forest in Mussoorie.

1st February, 1887. VINCENT MACKINNON.

The Municipality of Mussoorie, and indeed all our Hill Station Municipalities, should have a good Forest Ranger in charge of their forests and plantations, and the visitors' jampánis who search the hill-side for grass and dead wood should receive permits, and, generally, some attempt should be made to preserve the beautiful aspects of nature, in these health resorts.—[ED.]

PUBLIC SERVICE COMMISSION.

WE see from a resolution of the Government of India that a Sub-Committee of the Public Service Commission is now to enquire into the admission of Natives of India and of Europeans to the various branches of the Public Service of India, including the Forest Service.

The Sub-Committee will be composed of certain members of the Public Service Commission, with the addition of professional colleagues, to use the words of the resolution.

"It has therefore been decided with a view to distribution of labour and the utilization of local knowledge, that the enquiry relating to the special Branches of the Public Service enumerated in the preceding paragraph shall be conducted by a Sub-Committee consisting of six members, one of whom, Sir Charles Turner, C.I.E., will also be President of the Sub-Committee. With him will be associated the Honourable J. W. Quinton, C.S.I.; and the Hindu, the Muhammadan and the Eurasian members of the Commission, for such period as may

be devoted to the enquiry in the Province to which they belong. As the Public Service Commission does not contain a Muhammadan member from Madras or Bengal, nor an Eurasian member from Bombay or the North-Western Provinces, the Local Governments of those Provinces will nominate as local member of the Sub-Committee a Muhammadan or Eurasian member as required. Finally, each Local Government will be requested to nominate to the Sub-Committee for duty while engaged within its jurisdiction a local member, selected from the Department or Branch of the Public Service which is being passed under review, whose duty it will be to bring his local knowledge and professional experience to the assistance of the Committee in obtaining accurate and complete information on the special subject with which it is dealing, and in testing the evidence of witnesses on technical points.

"The Sub-Committee thus constituted will exercise all the powers vested in the Public Service Commission by the Resolution cited in the preamble and by the orders passed in connexion with it; and the Secretary of the Public Service Commission will also, so far as may be necessary and so far as his current duties under the Commission permits, act as Secretary of the Sub-Committee.

"It will be the duty of the Sub-Committee to obtain and digest evidence on definite questions of fact to be placed before the Public Service Commission when it re-assembles later in the year. The subjects of the Sub-Committee's enquiry are, first, the present regulations of the various Departments as to admission to the various grades and ranks in each; the conditions of service in each Department, and the capacity for rendering efficient service therein, of the various classes who put forward claims to such employment. The professional or departmental member should bring clearly and accurately before the Committee by means of evidence the existing organization of the Department, its technical requirements, the professional attainments essential for efficient service in its various branches, and the results of local experience as to the comparative value of the services rendered by persons of various classes now employed in the Department. It will be convenient that the Sub-Committee should closely restrict the scope of its enquiry to the practical issues which it is desired to elucidate.

"His Excellency in Council desires that every class of Her Majesty's subjects in India shall have full opportunity to explain and illustrate its claims through representative witnesses on all the subjects of enquiry."

We may trust that Local Governments will select such Forest officers to give evidence in the different provinces whose experience in the service, and professional knowledge may ensure the benefits the Department has conferred on India being set forth in the clearest manner. Every Forest officer who has visited America, speaks in the gloomiest manner of the destruction of the physical configuration and fertility of the country, which has resulted from a thorough neglect of forest protection, in that country, and we are assured that, unless our Department in India retains a nucleus of highly trained officers, whose position and education enable them to treat with District officers

on equal social terms, the efficient protection of Indian forests will not be maintained.

RHYMING REPORT OF THE FOREST CONFERENCE.

You have, I think, gone beyond your rights as an Editor in altering the rhyming lines I sent you on the late Conference, without in any way giving your readers a hint that you had done so. I must disown lines 15 to 20 from the beginning. You will excuse my criticising your lines, as you have ruthlessly cut mine out altogether, and changed the sense of what I wrote. Mine gave what the Conference arrived at, *viz.*, that we changed your curriculum greatly, and laid down one that made you work more out-door than in. Your lines give no conclusion at all, and limp badly. Again, your last two lines on the section on light grazing, with which you replaced mine, do not state the conclusion the Conference arrived at, but one of your own, apparently. For six lines of mine on using the "Forester" for advertising, you have substituted two limping lines, and lines that are scarcely grammatical. In other places, you have made other changes, and in one, interpolated four lines for which I am in no way responsible. I must ask you to print this protest as I write it, for while I am prepared to stand by what I write, and to be criticised for what I put forward, you must surely allow that wholesale changes without his concurrence or knowledge, and without a hint that you have made them, are unfair to a writer, and scarcely come within what is meant by editing.

BERAR,
9th March, 1887.

G. J. v S.

NOTE.—We must apologize to "G. J. v S." for taking liberties with his verses, but the alterations complained of were dictated with the view of giving what we considered a correct account of the proceedings of the Conference, as the official report of it is not yet forthcoming; we can only regret the lameness of our Pegasus, which may be partly due to want of exercise, the stern duties of a Forester seldom allowing time for versification.

"G. J. v S." is wrong in thinking that one result of the Conference was that the school work has become "more out-door than in," for the only changes really made in the curriculum are the introduction of theoretical Forestry into the work of the first four months, July to November, and the curtailing of the Physical Sciences course, now restricted to the first year.

Practical instruction in the forests remains just as it was in 1885-86, *viz.*, the students will, as before, be in camp in the forests from November to June, in the first year, and from November to March, in the second year, the only changes being that, a fortnight's holiday is allowed at Christmas, and the school will close during the month of June, while, formerly, practical forest work went on uninterruptedly throughout the year. It would be really more correct to say that a result of the Conference is to increase the time allotted to theoretical Forestry, and to curtail by six weeks the period of practical instruction, though doubtless, the quality of the latter will constantly improve with enlarged experience, but this will be due to the efforts of the School Staff, which have always had this end in view, and not to any suggestions of the Conference; the importance of practical forest work having always been fully recognized at Dehra.—[ED.]

INDENTS FOR TIMBER BY THE PUBLIC WORKS DEPARTMENT.

"The Government of India having had under consideration the desirability of the more extensive supply of timber by the Forest Department to State Railways, is pleased to empower Managers of open lines of State Railways to call for, and accept, tenders from the Forest Department, for the supply of wooden sleepers for two or three years in advance, subject to the restrictions that such advance orders should be confined to the quantities estimated to be necessary for normal or ordinary renewal requirements, and be only given in cases where there is no room for uncertainty as to the nature of the sleeper which will be required for such purposes."

We have permission to publish the above Resolution of the Government of India in the Public Works Department. The powers conceded in this Resolution to Managers of State Railways cannot but prove welcome to Conservators of Forests, giving promise, as they do, of a new era in the transactions between the two Departments, and of a termination to all that inconvenience, occasionally accompanied by pecuniary loss, to which both contracting parties had been hitherto subject, by reason of no timely notice being forthcoming, which could enable the Forest Department to meet, in the spirit and in the letter, the demands of what ought to be its most important customer.

When it is borne in mind that the Public Works Department has, on divers occasions, through the inability of Forest officers to accept its sudden tenders, been reduced to obtain timber from unnecessarily great distances, or from private dealers at unnecessarily high rates, or has seen itself forced to reject the green timber prepared for it by the Forest Department in favour of more seasoned material in the hands of merchants—by which course Government has, in some instances, lost heavily through the Forest Department not having been able to dispose of the stock thus rejected—it is evident that the present Resolution should have most important results, that it should conduce to a more economical management of the State Railways, as also to a more certain, more systematic, and more intense working of the State forests.

FOREST PESTS.

I suppose that Forest officers would consider the greatest forest pest to be the person who sets fire to a forest, to be revenged on some one who has thwarted him in some way or other; but for a visitor to forests as I was last month, a small tick (*acarus*) may fairly be classed as a great forest pest.

In the forests of the Dún and Bijnor Districts, I have never met with this insect, but as you go further south-east it gradually gets worse, till it seems to culminate in the Gorakhpur District. There you cannot walk in the forest without getting numbers on you. You cannot feel it crawling on your skin, and it gets its forceps deep into your flesh before you are aware of its presence, and when removed it tears away skin and flesh, and you feel the pain for weeks afterwards. I heard of two circumstances that will illustrate what has been said and show what this little pest can do. One of the Forest guards shot a chítal one day, and as he could not get any one to help him to carry it, he carried it himself on his shoulders. The ticks left the dead animal when it got cold, and attached themselves to the man, he had them picked off, but there were so many of them, and the sores got so bad, that he was laid up for a month. In the late sleeper operations in this district it was intended at first to saw up the trees in the place where they were felled, so as to save expense, but after the sawyers had been at work three days they found that they could not lift their arms, the pain was so great from the removal of the vast numbers of ticks that had stuck to them; there was nothing for it, but to cart out the trees to depôts in the open. The fellers of the trees were used to the forests, and did not allow the ticks to get established on them, but the sawyers, drawn from all parts, and working longer in one place, could not take such care of themselves, and so the ticks upset the working plan, and greatly increased the expenditure.

A. C.

SOWING AND PLANTING BAMBOOS.

I WAS shown the other day in the Rámgarh Division of the Gorakhpur forests some clumps of bamboos raised from seed that seemed to me, to have done extra well, and as I have not seen the system of sowing and planting adopted with these described, it may be useful to some to know it. Earthern garrahs are cheap in the Gorakhpur district. 100 can be purchased for a rupee, these are taken, and five small holes for drainage purposes are made in the bottom, they are then filled with good soil and from 8 to 10 seeds sown in them, this is done at the beginning of spring. The garrahs are then placed in the ground close together, and earth filled in around them, they should be near a well for convenience of watering which is done regularly. When the rains commence, the garrahs containing the seedlings are taken in banghies to the place where they are to be planted; holes 3 feet diameter and 3 feet deep having previously been dug, and filled with a mixture of earth and leaf mould, the

garrah is placed on this earth with the top well above the surface of the ground; the garrah is then broken and removed, and the earth pressed round the mass of fibrous roots that the ball of earth contains; no more attention is given to them, and by the end of the rains the shoots are well up. Measurements were not taken, but when removed for planting they were some 2 feet high, and at end of the rains double this height. Now when they are five years old from seed they are fully established, and have culms 50 to 60 feet high, looking almost as well as clumps that were planted 13 years ago. The kind of bamboo planted is called by the natives Katbans (*Dendrocalamus strictus?*)

A. C.

GERMINATION OF BABUL SEEDS.

READING "G. J. v S.'s" remarks on this subject in the February number of the "Indian Forester," it occurred to me that the following details of an experiment carried out in this District might be of interest, and tend to throw a little light on the subject, though the results are far from conclusive.

Orders were given in February 1886, to allow goats to graze and obtain babul pods and seeds for a limited time in a reserve where babul was plentiful, and to fold them at night in another part of the reserve, where the ground was absolutely bare of any vegetation.

The experiment was commenced by my predecessor just before giving over charge to me, and the spot chosen being in a remote part of the district, and difficult of access, I was unable to observe the progress of the experiment personally. At the present time, however, there is in the place where the animals were folded a fair crop of young seedlings, averaging some three to four inches in height. The Range Forest officer of the Taluka reports, as the results of his observations, that most of these seedlings have sprung from seeds fallen or ejected from the animals' mouths, but that undoubtedly some of them have come from seeds that have passed through the stomach of the animals and been voided in their droppings.

This of course proves but little, *viz.*, only that some seeds are voided and germinate, but by further experiments and personal observation and precautions, I shall attempt this year to obtain more precise information as to the greater adaptability or otherwise for germination of seed that has had such treatment.

SHOLAPUR, DECCAN,
20th February, 1887. G. P. M.

A REAL WEEPING TREE.

ON my way to and from the Mussoorie Library I have noticed for some days a small pool of water in the middle of the road just above "Auchnagie."

It struck me as being something singular; and to-day when passing I noticed several drops of water fall into it; on looking up I saw that it was the sap from a branch high upon a tree that was falling into it; the drops were large and were falling at the rate of one a second. I afterwards noticed several other trees of the same kind on the roadside dropping sap from their branches in the same way. The tree is a large one, called by the natives Kágashi (*Cornus macrophylla?*) In the spring if the bark of this tree is wounded by an axe, the sap runs out of the wound in a great stream; some of it solidifies into a thick mucilage of a bright orange colour; it was from a broken branch that the sap was coming, broken most likely by the heavy fall of snow we had at the end of January. These trees are just bursting into leaf, but they have been weeping for the last ten days at least.

A. C.

THE INDIAN FOREST SERVICE.

REFERRING to the list of Rangers given on page 107 of the March Number, a correspondent has kindly informed us that in Bombay and Sindh the number of sanctioned Sub-Assistants and Rangers is as follows :—

Salary in Rupees.					Total.
200 to 150	100	70 to 80	60	50	
13	5	8	8	15	49

We do not include men on less pay than Rs. 50, though Range officers in Bombay draw salaries down to Rs. 20 per mensem. This brings up the total number of Sub-Assistants in India to 62, and of Rangers to 200. Many of the Sub-Assistants are in charge of divisions, and the number of Rangers is very far from Sir D. Brandis' estimate of 1,000 or 1,500, though we have little doubt that if each member of the executive staff were entrusted with an area of forest which he could really manage efficiently, that the above numbers would not be found excessive. If one of our friends in each circle or province

could kindly inform us what are the number of ranges into which the forest could be fairly divided, and the area of each, and under men of what grade they are at present, it would be highly instructive.

CLEARING FIRE-LINES OF FOREST GROWTH.

I SHOULD be glad to hear what other officers say to the following proposal—not, I believe, by any means a new one, yet not as yet carried out on a large scale anywhere that I know of. In burning the fire-lines of plains' Divisions, would it not be advisable to remove all the timber from the middle part, leaving, however, a fringe of tree-shade along each edge? By doing this, the grass on the exposed part would dry before the grass in the forest, and would also burn much more clearly, and the danger of a furious blaze, when burning the line, would be obviated by the presence of the fringe of shade (and consequently of somewhat greener grass) along the edges. Since the trees on the line are annually to undergo scorching, we cannot expect them to come to much good, and may as well sell them. I suspect too, that the lines could be burned more quickly, in addition to the important consideration that they could be burned earlier. Of course this plan should only be adopted where there was no doubt that the position of the line would never be changed. If there is anything to urge against this plan, I should be glad to hear it.

Q.

THE SALE OF OIL IN SWEDEN.—A new branch of trade has sprung up in Sweden, and promises to become very important. Oil for illuminating purposes is extracted by dry distillation from the stumps and roots of trees remaining after a wood has been cut down. Other products are also obtained, such as turpentine, creosote, acetic acid, and tar. This oil, however, cannot be burned in ordinary lamps, as it contains too much carbon, and throws off too much smoke. Mixed with benzine, it can be burned in ordinary benzine lamps. Factories have already been started, and there should be a considerable field here for the carrying on of this new kind of industry.—*Timber Trades Journal.*

III. NOTES, QUERIES AND EXTRACTS.

TABASHEER.—I have often wondered that this curious substance has never attracted more attention. But scanty references to it are to be found in books, and yet it seems to me that few more singular things are to be met with in the vegetable kingdom.

In Watts's "Dictionary of Chemistry," (Vol. V., p. 653), exactly six lines are devoted to it. It is defined to be: "Hydrated silica, occurring in stony concretions in the joints of the bamboo. It resembles hydrophane, and when thrown upon water does not sink till completely saturated therewith." It is further stated to be the least refractive of all known solids, and an analysis by Rost von Tonningen of a specimen from Java gives a composition of 86·39 per cent. silica soluble in potash, 4·81 potash, 7·63 water, with traces of ferric oxide (to which I suppose its occasional yellowish colour to be due), lime, and organic matter.

There are several specimens in the Kew Museums, partly derived from the India Museum. All consist of small irregular angular fragments, varying from the size of a pea downwards, and opaque white in colour. It is obvious that these fragments are the débris of large masses.

Now, the presence of considerable solid masses of so inert a substance as hydrated silica in the plant-body is a striking fact. At first sight, one might compare it to the masses of calcium phosphate which form the endo-skeleton in the higher animals. These, however, serve an obvious mechanical purpose, which cannot be attributed to the lumps of tabasheer in the hollow joints of a bamboo. The presence of silica may sometimes serve an adaptive purpose, as in the beautiful enamelled surface of canes. And according to Dr. Vines ("Physiology of Plants," p. 21), "Struve found that it constitutes 99 per cent. of the dry epidermis of *Calamus Rotang*."*

In a few other groups of plants, such as *Equisetum* and the *Diatomaceæ*, it is a characteristic constituent. In all cases it principally occurs in the cell-wall (Vines, *l.c.*, p. 137). This has suggested the highly ingenious speculation that, seeing the intimate chemical relationship which obtains between silicon and

* Sachs remarks ("Text-book," second edition, p. 700) that silica accumulates chiefly in the tissues exposed to evaporation, though this clearly does not apply to the case of diatoms.

carbon, there might be a silicon-cellulose. I notice that Count Castracane, in his Report on the *Diatomaceæ* collected by the *Challenger*, speaks of its "having been already shown that silica is sometimes substituted for carbon in the formation of cellulose" (p. 7). Judging from ash-analyses it might be supposed that silica was an essential constituent of gramineous plants. But by the method of water-culture Sachs has found that maize, for example, will grow with only a trace of silica. I must confess to ignorance of all that may have been done in the matter recently. But Ladenburg thought, and I think with reason, that the indifference of the plant to silica was a strong argument for a silicon-cellulose in which silicon might or might not with equal physiological convenience play the part of one or more atoms of carbon. Fascinating as this hypothesis is, I am bound to say that the prolonged investigation which he devoted to the question is on the whole adverse to the idea of silicon playing any part of the kind.

It still remains then an unsolved problem why, when no adaptive end is involved, plants should take up such relatively enormous quantities of silica. The case of the frustules of *Diatomaceæ* is peculiar, as there the silicious wall is apparently a continuous plate of inorganic matter capable of resisting, without impairment, treatment by the most destructive and disintegrating agencies known. Yet Castracane adduces evidence to show that such walls can grow; and as this can only be by interstitial growth, a molecular constitution is implied quite different from anything physical, and precisely similar to that of a cellulose membrane. He quotes, indeed, von Mohl for the opinion that the wall is not simply inorganic, "but only an organic membrane which is impregnated with silex."

Now, in the case of tabasheer, it is quite evident that the plant takes up an amount of silica beyond its powers to use, and so it is exuded into the hollow cavities of the bamboo stem. I do not mind confessing that, in so far as I had reflected on the matter at all, I had pictured to myself this as taking place by some process of secretion, so that the mass of tabasheer ultimately accumulated from successive portions of thrown-off silica. I was obliged, however, to give a little more serious thought to the matter when Prof. Cohn, of Breslau, wrote to me that he proposed to investigate the whole subject, and asked for help in the way of specimens and information. It then struck me what a very singular thing the phenomenon of the occurrence of tabasheer really was. I set to work to hunt up in the literature of Indian botany some rational account of the matter. The only ray of light I got was from the "Forest Flora of North-West and Central India," by Dr. Brandis, late Inspector-General of Forests to the Government of India. Everyone who knows Dr. Brandis knows that he gave to administration the energy he would more willing have devoted to

scientific pursuits. I was not at all surprised to find, therefore, modestly hidden in his book (p. 566) *the key to the riddle.* He says: It is not at all impossible that the well known silicious deposit *(tabasheer)* which is found in the joints of this and other species [*Bambusa arundinacea*] may be the residuum of the fluid which often fills the joints." I communicated this to Prof. Cohn, and he was good enough to tell me that he quite agreed that this was the correct explanation. I at the same time wrote to Dr. King, the distinguished Superintendent of the Royal Botanic Garden, Calcutta, to know if it were possible to procure specimens of tabasheer *in situ*, as we possessed in our Museum nothing but broken fragments. I extract from several letters he has written me the following particulars :—"January 11. I have inquired of several old workers as to the situation tabasheer occupies. They all say it is found either on the *floor* of the joint, or if (as is so often the case in *B. Tulda*) the stem *leans over, it is also found on the lower wall. It is never found* on the roof of a joint. . . . . Tabasheer is not common in bamboo grown near Calcutta. And, besides, it is apt to be forced out of its natural position by the force used in breaking a joint open. There is no external mark by which a tabasheer-bearing joint can be recognised prior to being opened." "January 18. I have got a specimen of tabasheer *in situ* for you. It concretes *as a jelly*, and is now being carefully dried off."

I think that these extracts (in which the italics are mine) fully confirm the explanation as far as I know first put out by Dr. Brandis. The rapidity of growth of a bamboo shoot is well known to be enormous. The root-pressure is probably equally great. The joints, at first solid, become hollow by the rending apart of the internal tissues, and water containing silica in solution is poured out into the cavities so formed. When the foliage is developed, transpiration is active : the water taken up from the ground is rapidly got rid of; not merely is the root-pressure compensated, but the water poured out into the joints is re-absorbed. It is not easy to see why the silica should not be always taken with it, as in the vast majority of cases *it no doubt is. But in the cases in which it is left behind* it has apparently simply undergone a process of dialysis. The determining causes of the occasional deposit of tabasheer are, I think, still obscure. But, as Prof. Cohn intends to investigate the subject, I think we may pretty confidently look forward to an exhaustive explanation.

It is a well-known fact that a large proportion of the ash-constituents of plants may have but little significance in their nutrition. The chemical constitution of plants, as far as their ash is concerned, to a large extent varies with the nature of the soil in which they are grown. It is quite certain that they will in consequence take up a vastly larger proportion of certain constituents than they can turn to any physiological account. Ta-

basheer is a striking instance of one such case. The calcareous massses found in the wood of many Indian trees mentioned in "Nature," Vol. XXI., p. 376, affords another.—W. T. THISELTON DYER.—*Nature.*

DESTRUCTION OF GAME IN GOVERNMENT RESERVES DURING THE RAINS.—With reference to the letters signed "H. L." and "H. H. L." on game preservation and closed forests, which appeared in the "Asian" some time since, and your article on the same subject in your issue of the 28th December. I shall feel obliged if you will kindly afford me space to make known to the sporting public some startling facts regarding the unlawful destruction of game in the Government closed forests which have lately come under my notice. The greatest destruction, I might even say slaughter, on an extensive scale, takes place in the Sewaliks and adjoining forests during the rains, that is between the months of July and September, when, owing to the absence of danger to the forests from fire, and the unhealthiness of the season, the presence of the usual forest guards is considered unnecessary at one or two stations, but unfortunately as regards game very important ones, so that there is no one left at these chokis to enforce, or at least to a certain extent regulate, the new game laws so clearly stated in the recent forest circular on this subject, and in which, besides the prohibition with regard to shooting does, young stags, &c., it is distinctly specified that no sambhar (maha or jerao) are to be shot between the 30th of April and the 1st of October.

I shall endeavour to show you in this letter how far these rules are observed by irresponsible native shikaries. I have lately come across rough chapars or shanties, large enough to accommodate six or seven persons on the banks of raos or dry water-courses in the Sewaliks, and on enquiry was told that they were erected and used by the local shikaries in the rains; and round about these temporary abodes, pegs for stretching skins, charred bones and other outward and visible signs of a hunter's abode were apparent. Many of the villages adjoining the Sewaliks are inhabited by Gurkhas and others, several of whom have either guns of their own or have no difficulty in borrowing them from the zemindars. These men tell you openly that the best sport in the Sewaliks is to be had in the rains, when, owing to the myriads of various kinds of flies and other vermin incidental to that season, the animals are driven down to the dry and comparatively open water-courses, and may be seen in considerable numbers standing about here and there, driving away their tormentors. It is during this season, when the climate is baneful, except to the jungly and acclimatised villagers, that the game is killed to an extent that would make persons unac-

quainted with these facts gasp and stare. Shooting with these men at this season is a trade and a profession, and as long as they can get the skins and meat they consider it unnecessary to trouble themselves about the sex or age of their victims.

It is not uncommonly asked how it is that, notwithstanding the most stringent forest rules, the game does not appear to increase even in the Sewaliks; but any one taking the trouble to enquire will not have far to seek for an answer. It is simply this, that the does and fawns are spared by sportsmen during the months that the forests are open, only to be slaughtered by irresponsible poachers later on, and in the rainy season.

As an instance also how mercilessly the game here is hunted by others besides *boná fide* sportsmen, I might mention that on one occasion last season I met a gang of seven or eight of these unlicensed shikaries camped on the borders of the closed forest, which they daily visited; and I subsequently heard that they had made an excellent bag of does. Now it was clearly the duty of the forest guard in charge of the choki to report these men, but during my stay in that neighbourhood they were allowed to remain unmolested. This is a serious evil, and well worthy the attention of forest officers and others interested in the preservation of game. No doubt the root of the evil lies in the careless and promiscuous way licenses are granted to villagers, ostensibly for the protection of their fields. The guns thus allowed them are lent to and used by persons of their own community, who for the time being convert themselves into game butchers and skin dealers, and prowl about the closed forests at the season already referred to. Besides, for every licensed gun in a village, there are half a dozen for the possession of which their owners have no authority. Your suggestion that, "for the protection of crops, a gun with a barrel only a few inches long would be quite efficacious" is excellent, and should be borne in mind by the civil authorities when issuing licenses to the zemindars. Even if nothing were said as to the efficiency or otherwise of his licensed gun, the zemindar should be distinctly made to understand that, if found in his possession or in the hands of a shikari outside his fields, or anywhere within the forest limits, he would be rendering himself liable to a heavy fine, imprisonment, or in fact any punishment suited to the gravity of the offence. The patrols, guards and all other forest subordinates should be made thoroughly acquainted with these rules, and in some measure held responsible for their efficient working. Until this is done I don't see how game is to be successfully preserved. "The closing of large areas of forest land, during certain seasons, affects sportsmen at present." No doubt it does, but for their benefit and advantage. Still game is getting thinned out, even in these comparative preserves, and there is no knowing how scarce it would become if the forests were open throughout the year. Any argument based on the abundance of game in form-

er years, when none of the forests were closed to the public, is untenable now, since in those days sportsmen were not so numerous and there was also more jungle. With due deference also to the opinion of your correspondent "H. L." embodied in your remark "that the system of closing the forests must in a short time lead to an excessive increase of dangerous and destructive animals" is somewhat fanciful, for our friend, the poacher, and others of his class, are sworn enemies to stripes and his kindred, and spare no pains to add them also to their bags whenever they visit the forests. As to wild elephants the periodical kheddar are sufficient to keep them down.

Rules and regulations regarding fishing are quite as carelessly enforced, though on paper and printed circulars they appear formidable enough. There is not a village perhaps in the Dún in which there are not several nets with meshes far smaller than the prescribed 1½-inch mesh. These are used at nights and openly during the rainy season, when, I might say, maunds of fish are caught, dried and sold. But, as in the case of shooting, extra supervision and more stringent instructions to the forest guards and patrols are necessary, if it is desired that the game laws should be something more than a dead letter and a matter of form.—GAME-KEEPER.

DEHRA, *31st January, 1887.* —*Asian.*

HYBRID POTATOS.—The following notice on this subject appeared in the "Times" in November last:—

"It is known that the species of potatos, *Solanum tuberosum*, from which all the varieties in cultivation sprung, is a native of the higher Andes mountains, where rain is almost unknown, and the varieties we possess may therefore be liable to degeneration in stamina in our moist climate. But there exist other varieties of potato which had never been cultivated before recent experiments were made. One of them is the *Solanum maglia*, discovered by Darwin in the Chonos Archipelago, 44 degrees to 46 degrees south latitude; and this plant is remarkable as choosing for its habitat low-lying marshy places near the coast. Could the *Solanum maglia* be made the parent of a sort of potato which would not be averse to humidity, and would not become affected by the *Peronospera infetans*, or potato disease?

"At the instigation of Earl Cathcart, who procured from Mr. Baker of Kew, tubers believed to be of the new variety, Mr. Arthur W. Sutton of Reading, commenced in 1884 the important and hopeful experiments which have now reached a mature stage. The so-called *Solanum maglia* bore abundant flowers, but had never been known to yield a seed-berry. The red-skinned tubers were started in pots, and care was taken to fertilize the flowers with pollen from some of the best so-called disease-

resisting potatos at present in cultivation." Three fully developed berries, well-filled with seed, were obtained, and these were sown to produce seedlings in 1885. The effect of cultivation upon the *Solanum maglia* was, that while the tubers received from Lord Cathcart were about the size of a pigeon's egg, the produce of the first year's growth consisted of tubers quite as large as an ordinary potato, with as many as eight up to twelve tubers to a root. Cooked they proved of fair quality for the table. There now remains to follow the fortunes of the seedlings to the present time.

On Monday a number of scientific gentlemen, including Dr. Hogg, Dr. Masters, Mr. Shirley Hibberd, and other authorities in potato history, visited Messrs. Sutton and Sons' trial grounds at Reading to notice the experiments, which have been very successful and satisfactory. It is agreed that the parent in the cross was not, after all, a true specimen of *Solanum maglia*, but was a specimen of a wild form of *Solanum tuberosum* of a distinctly different geographical origin from the variety which furnished the varieties commonly cultivated, and this wild form has been preserved for many years at Kew gardens in a bed side by side with the plants of *Solanum maglia*. Twenty-three plants were obtained from the seed grains in 1885, and the tubers set again in the present year vastly increased in weight, up to 122 lbs. from 13½ oz. The cross is between the wild *Solanum tuberosum* and the variety known as Sutton's Reading Russet. In point of quality and shapely form, they leave nothing to be desired, and reach a high standard of merit. Several other crosses have been obtained in this first attempt to introduce new blood into the potato, successful hybrids being bred from the wild species crossed with Walker's Regent, Paterson's Victoria, and other popular varieties."

Mr. A. H. Blechynden writes to the Society from London on the subject as follows :—

"The subject of potato hybridisation has been recently engaging the attention of horticulturists in this country as a reference to the accompanying* printed papers will show. Under the impression that it may be considered desirable to make an experiment in the economic portion of the Society's garden, I have been in communication with Mr. Arthur Sutton, of Sutton and Sons of Reading, and the authorities at Kew. I now enclose a letter from Mr. Sutton on the subject, and forward a few tubers of *Solanum maglia* just received from Kew. It is probable as *S. maglia* prefers low-lying marshy places, that a cross between it and *S. tuberosum* (should you succeed in effecting it) could be successfully introduced in similar localities in India, where the

* A copy of the "Times" of 29th November, 1884.
The "Journal of Horticulture" for 18th November, 1886, and scraps from the "Times" and "Daily Telegraph" of November 1886.

ordinary potato cannot be advantageously cultivated. Under any circumstances it is worth a trial.

"Should it be deemed desirable I will accept Mr. Sutton's kind offer of a supply of the wild form of *S. tuberosum.*"

The following is the letter from Mr. Sutton referred to :—

"In reply to your letter of the 22nd instant, I regret that our stock of the true *Solanum maglia* is exceedingly limited, although we have a very large quantity of a wild form of *S. tuberosum* which has been cultivated for some 30 years past in the Royal Gardens at Kew.

"I shall be very glad indeed to ask your acceptance of some of the latter, and if you would also like some of the *S. maglia* I am sure Mr. Baker, the Curator of the Royal Herbarium at Kew, would be most happy to supply you.

"As you may have gathered from some of the reports appearing in the press, it is now ascertained that the tubers we have been experimenting on under the name of *S. maglia* were really the wild form of *S. tuberosum* above referred to, which had been sent to Lord Cathcart by mistake. Awaiting your reply.

"*P.S.*—I send you by this post a copy of the "Times" for November 29th, 1884, and the "Journal of Horticulture" for last week, which contain some interesting matter in connection with our potato experiments."

The *S. maglia* tubers have been duly received. As this is an unsuitable time for planting them in Bengal, the Society propose to send them to Darjeeling to be grown, and the increased stock can be planted here in October or November.—*Proc. of Agri-Horticultural Society of Madras, January 1887.*

THE PRESERVATION OF FISH IN THE PUNJAB.—With reference to the letter of Mr. H. S. Dunsford, in your issue of the 20th instant, regarding the preservation of fish in the Punjab, I should, as Honorary Secretary of the North Punjab Fishing Club, like to say a few words. As stated in the above letter, the Punjab Government are averse to forwarding for the information and consideration of Government, the letter written by General H. C. Wilkinson, C.B., late President of this Club recommending that a Fishing Act should be enforced, and submitting certain propositions which he considered necessary to be enforced, in order to check the enormous destruction of small fish; which goes on by every possible variety of methods in almost all the small tributary streams of the Punjab. They, however, referred to a letter received from Government in reply to a letter of Sir Robert Egerton's, the late Lieutenant-Governor of the Punjab, submitting a draft Act and rules for the preservation of fish in the Punjab, as long ago as 1880, in which it was stated that, although the Government did not at the time consider such legislation desirable, nevertheless, if at any future

period the evil was attaining more serious proportions they would be willing to reconsider Sir Robert Egerton's opinion. The question now arises as to how evidence is to be collected showing that the evil has greatly increased, and has attained serious proportions referred to since the time when Sir Robert Egerton's draft Act was submitted. This I believe could be done if every one interested in the subject in the Punjab would compile briefly a few notes of the actual destruction of small fish that may have come to their personal notice; giving such information as they might be able to on the various descriptions and methods of destruction employed for the purpose.

If every member of the North Punjab Fishing Club, who is able to, would forward such a statement as is above referred to, a large mass of evidence would be collected and compiled, which doubtless would have great weight; and perhaps would be ultimately the means of the opinion of Sir Robert Egerton being reconsidered.

In this work the hearty co-operation of others, more especially of district officers, is solicited—even although they themselves may not be members of the Club. I would venture to say that in this manner, a formidable mass of the most reliable evidence could be collected. The evil at present is very great, and the small fish in the higher beds and small tributary streams get no chance. I believe that India is almost the only country in the world where Fishery Laws are not enforced. In China, where the fish-eating population is enormous, and a vast consumption, of fish takes place, the supply has not failed, and this is entirely due to a wise and careful legislation for the preservation of this important food supply. With reference to Mr. H. S. Dunsford's remark, that he does not consider that the chief depredators on our rivers are vagrants of no fixed residence, I would point out that this remark only referred to the streams in the vicinity of Rawalpindi, where such is actually the case; as can be proved by all land-owners on the adjoining banks. Farther down country, where the inferior Hindu population is of a different class, and far greater in number than in this part of the country, each village has its regular fishermen, and netters, as Mr. Dunsford states; but this is not the case in the Northern Punjab. In conclusion, I would briefly refer to the very spirited action of the Kashmir authorities, in prohibiting the destruction of fish in the Kashmir and Jummú territories by the use of dynamite. Also to Rajah Moti Singh of Púnch, who has promised to prohibit the use of small mesh nets in the river Púnch from Tangrot to Kotti, and in certain parts of the river Mahal. Moreover, I hear from the Púnch, that the most stringent orders on the subject have been issued. The thanks of all fishermen are due for this legislation on the Púnch, one of the finest, if not the best, fishing rivers in India.

It is to be hoped that this year will see a large increase in the

numbers of the North Punjab Fishing Club. Prospectuses and all necessary information about the Club can be obtained on application to the undersigned, by those wishing to join; and fishing diaries, maps of new fishing grounds, and other information will gladly be received and published.—G. H. LACY, *Hon. Secy. North Punjab Fishing Club.*

RAWALPINDI, *22nd January, 1887.*—*C. & M. Gazette*, reprinted from *Indian Agriculturist.*

OUR FOREST LAWS AS THEY ARE MADE APPLICABLE TO GOVERNMENT RESERVES.—I am sure most of your readers interested in the preservation of game in our forests would be most thankful to "Game-keeper" for his able article in your issue of 8th February on a subject that much deserves the attention of the authorities concerned. I am sorry to state that matters are not different down here—as regards the lawless and ruthless destruction by the hill tribe, the Malayalies, in the face of the most rigid and appropriate law as it would seem protecting a forest. This may appear very incredulous to those working in the forest, but they may not be aware that the Malayalies as a set are very acute, and are apt to set at nought the keenest arrangements the authorities may come to with the object of preventing poaching.

The Coffee Stealing Act, as far as they (the Malayalies) are concerned, we know is a dead letter. They have set the law at defiance. They never carry coffee now, but sell under an arrangement in the village, so that section 10 of the Act is not made applicable.

One *not* owning an estate, and who is in possession of coffee, has simply to make over his share to one who owns an estate, and the latter sells to the Chetty both as his own. So that virtually twenty men sell, but only ten own estates, come forward with the bulk of coffee, and the Chetty cannot help but making the entry in his pass book (under section 5) that so many maunds of coffee was purchased from the ten. Now let us see how the Malayalies get what they want in the reserves.

They have simply to come to terms with the forest guards, and there is not the slightest doubt about this, from the fact of the Malayalies adopting their usual plan of going down to the plains periodically and bagging game in a most fashionable way as if there was no law in vogue to prevent them. It is not difficult to understand that the *guards* are willing to accept a small bribe, for their pay is a miserable pittance, just enough to keep them from starving. We wanted very much an enactment passed into law for the security and preservation of game, and we were under the impression that the forest law, which it behoved our Government to introduce, served our purposes

well, as, although it does not actually profess to be a game law yet, it would have had the desired effect if worked with a good deal of scrutiny.

One would suppose it to answer very well indeed taking into consideration the many obstacles thrown in the way of procuring a license to shoot in the reserves, and the several restrictions under which it is granted, and these we thought might also be a stumbling block in the way of the Malayalies.

Now to procure a license you have to attend personally at the forest office for the purpose of your identity being taken; on getting it it becomes useful only to you, as others accompanying you with guns have to take fresh licenses. You can hunt only during a portion of the year, the rest of it being the breeding season. The license is not transferable, and you cannot net or trap. You can only hunt in the reserve defined in the license. All these obstacles, as I call them, I thought would tend to stop the Malayalies from taking any license at all.

It is customary for them to go in large numbers—in fact a whole village turns out.

In this case in the least about 30 licenses would have to be taken, as about that number of guns are carried, and their most indispensable appendages, their traps and nets, they would have to leave behind. Under the forest laws can be seen now-a-days any number of tracts taken up as "Reserves" with sometimes a sprinkling of jungle in them. Posts are placed with pots whitewashed on them near each other defining the boundaries of the reserved land, so that no mistake could be made by trespassers. A duplicate of your license is in the hands of the forest guard, so that it is impossible to escape perception, and how comes it then that the Malayalies are bagging game in the usual way? I have known it to be the case, for four villages to have turned out separately and bagged for their respective lots a couple of deer or a wild boar. The whole of the forests, to the best of my knowledge adjoining the slopes of the Shevaroys to the west, have been so taken up, with the exception of some cultivation in two villages in the plains.

The reserves in some instances have come up to the precincts of the villages up here. And yet, is it not surprising, that all these precautions on the part of Government don't deter or slacken the usual custom of the Malayalies to cause such enormous destruction of game on the Shevaroys.

It would be a good plan if the forest authorities had their guards constantly shifted from place to place to prevent any intimacy growing between them and our hill men. On the slightest suspicion a strict and searching enquiry should take place. As we have "reserves" up here, it would be well to have a few peons stationed on the spot, for then we could communicate with them directly instead of, as it is now, having to send to the head office, some fifteen miles off, the delay

giving the trespassers ample time to hide and make themselves scarce.—W. M. D.

YERCAUD, SHEVABOYS, *26th February, 1887.* —*Asian.*

SUPPLYING WALNUT TO GOVERNMENT DEPARTMENTS.—In reply to "J. C. B." (Napoli) the walnut supplied to the Government factories, for manufacturing the butt and fore-end which compose the stock of small arms, is, we believe, almost entirely Italian. The wood must be of first-class quality, combining lightness, hardness, and closeness of grain. The rough butts and fore-ends are closely examined on arrival, and, should any of the following defects be observed, they are rejected :—(1) under size ; (2) crooked, at fore-ends only ; (3) galls, result of wound in tree ; (4) shakes or cracks ; (5) rindgalls, the result of injury to bark of tree when young ; (6) discoloured wood ; (7) bines or knots ; (8) cross-grain ; (9) bad quality ; (10) fly and worm holes ; (11) impregnation with salt water. All except the last of these defects are readily detected by the examiners, and should the appearance of the wood lead them to suppose that it has been damaged by salt water, a shaving is taken off with a spokeshave, and is dipped in a solution of nitrate of silver (1 grain in 1 ounce of distilled water) when, should any salt be present in the wood, a white precipitate is found of chloride of silver. If wood which has been damaged by salt water be used for a stock, it will rust any steel or iron with which it comes in contact ; and no method is known by which the salt can be removed from the wood when once damaged. The butts and fore-ends are usually in a half-seasoned condition when received, and are stocked to season. Green wood requires about three years to season. If it is necessary to hasten the seasoning of the wood it is placed in a desiccating room, and subjected to a heat of 60 degrees, gradually increasing to 90 degrees or 100 degrees Fahr. If half dry when placed in the desiccating room they will be ready for use in about six or seven weeks.—*Timber Trades Journal.*

MR. LOWRIE writes as follows from Ajmir :—"We are having a very bad time of it owing to the short rainfall. I have had to open out all the forest blocks this year for grazing, and though I have no doubt that the forests will be put back a few years, the help that the opening out of the blocks will give the villagers in tiding over their present difficulties, will be very great."

THE

INDIAN FORESTER.

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THE INDIAN FOREST SERVICE.

THE "Indian Agriculturist" still maintains that the Controlling Staff of the Forest Department should, after a few years, be *entirely selected in India*.

We have read evidence about Indian education brought before the Public Service Commission, and the complaint is constantly made, even by Natives, that education is superficial, and *that English professors are essential for any further improvement.* Can we allow our Department to be officered entirely by men of defective general education, and would it be possible in this case for us to resist the demands of *cultivators for fresh* rights and privileges in our forests, until all the good work of the last twenty years should be destroyed?

What has happened to the forests of Mysore, which British rule left in such magnificent condition to a Native rule? It would be highly instructive if officers who know their past and present condition would write an account of the change, for our pages.

The Forest Controlling Staff must consist of men of first class general education, of good social position, of great personal activity, and with a first class professional *training, and such* men are best obtained by public competition in London, followed by a technical education at Cooper's Hill.

The Cooper's Hill *appointments* are open to every one in the Empire, and the officers from that College are trained at their own expense, whilst in India we cannot train a Ranger without paying for him.

To say therefore, with the "Indian Agriculturist," that Government is actuated by a wish to maintain *vested interests* when it retains the Cooper's Hill training, is an indefensible statement.

Our Government has always shown the greatest public spirit in the establishment of the Forest Department, if it wished to go in for *vested interests*, the Department might have been kept

a Patronage Department, as the Police is at present, but the best German Forest officers have been engaged to organize our Department, and our Staff has been trained in France and Germany, and now that a strong Forest School for the Empire is established at Cooper's Hill, the "Indian Agriculturist" talks of *vested interests*. English fathers do not mind spending money on their sons, and Indian fathers can do the same, if they really wish their sons to enter our department, in the higher grades. Our present Forest Code provides for the promotion of deserving members of the Executive Staff to the Controlling Staff of the Forest Department, and a certain number of officers are thus promoted every year.

It is also, we believe, intended to improve the pay and prospects of the grade of Sub-Assistant Conservators, and these officers will of course be trained at the Dehra Dún Forest School.

The latter School is now fully employed in training a strong Executive Staff for the Forest Service, and to ask more of it, at present, is impossible.

OUR EMPIRE OF RIVERS.*

POLITICAL economists tell us that a Nation's wealth is derived, primarily, from its *Land, Labour and Capital.* But it does not require any prolonged disquisition to prove that, of these, by far the most important is the Nation's Land.

Labour and Capital are sources of wealth subsidiary to, and dependent upon, the fundamental origin of all prosperity—the Land.

People congregate in countries the land of which will yield them necessary sustenance; and whether, as years roll on, sufficient sustenance is forthcoming, or not, will largely depend, as can be indisputably proved, upon the wisdom and skill displayed by successive generations of inhabitants in their management of the soil.

It is one of the most hopeful prospects for the future of the human race—increasing as it is, at present, in number—that there exists tens of thousands of acres of cultivable land that can with ease and with certainty be rendered habitable by the practical exercise of man's intelligence. There are, for instance, tens of thousands of acres of arable land lying waste and uninhabited in certain parts of India, and again is such the case in Mexico, and indeed in other denuded and treeless countries. We all know, moreover, that cultivable lands, even in Great Britain, are offered for sale at the present day, to agriculturists,

* A Lecture delivered by R. T. Cooper, M.A., M.D., at the Balloon Society's Rooms, Royal Aquarium, 16th July, 1886, W. H. Le Fevre, Esq., C.E., Secretary of the Society, (in the unavoidable absence of Earl Caledon,) in the Chair.

at exceedingly reduced rates, and many formerly valuable and fertile properties are now lying idle. Emigration from Great Britain is not a cure for this melancholy condition of things existing in Great Britain, neither is emigration desirable, nor is it required, having regard to population and area. Thus, the total population of Great Britain is only thirty-four or thirty-five millions, while the total area is 69,430,659 acres.

Whether European countries are becoming over-populated, is a question we need not enter upon, more than to express the conviction that, at present, the land of Europe is supporting a population much inferior to that which it could do were it intelligently dealt with.

Properly distributed and intelligently supervised, the labour of mankind is capable of rendering the surface of the earth sufficiently fertile to support a population greater by far than that which now exists.

It is possible for man to neglect or mismanage land to a degree such as will render it unfit to support human life; the fact being that the material welfare and the creature comforts of a people depend in a large measure upon the mode in which land is cultivated, and the amount of care bestowed upon the subject by successive Governments.

Empires have become impoverished and degraded, and prosperity has become a thing of the past to many an ancient people, by whom the conservation of the soil was too little or unwisely considered. Entire districts of Greece, Asia Minor, Syria, Africa, and Spain have been deprived of great portions of their inhabitants; and when inquiry comes to be made we find the departure of man contemporary with the denudation of the soil. Poor Ireland, Scotland and many parts of France have suffered from this cause, and are still cruelly suffering.

If then, not only the decadence of the Imperial greatness of an Empire, but the very existence of the people themselves, is conterminous with the maintenance of a country's fertility, it becomes of pressing importance to attend to and intelligently direct those agents that are capable of exercising a destructive and devastating effect upon the soil.

Water—whether in the form of Rain or Snow, Lake or River—is, in disforested countries, the chief agent in effecting surface denudation; itself the symbol of motion, it flows on for ever, without rest and without fatigue. Traversing its eternal circuit through earth, air, and ocean, it denudes and destroys, or replenishes and supports, in accordance with the condition of the surfaces and channels with which it comes in contact.

Hurtful material is rendered innocuous in the great laboratory of nature by being kept constantly in active and natural movement.

It is obvious we must be continually imbibing germs that were once poisonous, the harmful nature of which has sustained

a change: and the evidence is very strong that this has been effected by the operations necessarily attendant upon their transposition through space. Dirt, Lord Palmerston defined to be "matter in the wrong place;" transpose it into the localities assigned to it by nature, and the opprobrious term becomes no longer applicable.

Here, then, may be said to be the key-note, from a sanitary point of view, to the remarks we are about to make regarding our rivers.

We owe a duty, not alone to those co-eval with us, but more a great deal to succeeding generations, in regard to the maintenance of the fertility of our soil. Our rivers may be said to be the great channels of change, the directing and distributing agents of land-waste; if these are neglected, stagnation and decay, in man and all his surroundings, will take the place of *prosperity and progress. Man has been philosophically defined* to be the expression of the soil; he thrives and developes co-incidentally with it. Woe be to the nation that loses sight of this cardinal fact! Already the master minds of the Brahmins of India are astir; they are determined no longer to sit idly by while they see the glorious rivers with which beneficent Nature has endowed their country—at the sources of which the priests of their great teacher, Buddha, placed their temples surrounded with forests—becoming muddy and impure, silting up and being rendered stagnant and useless.

This is matter of no small moment; for while it touches the sentiment, it very seriously involves the material prosperity, nay, the very existence, of the native Indian community.

The distresses of Ireland are far more the outcome of the neglect of her rivers and mountains and uplands than excited politicians are ready to admit, or than the Irish themselves avow.

Well, the streams and rivers of Ireland have their sources and catchment areas in Ireland, and when the authorities which are supposed to be governing Ireland shall have practically realized *the truths contained in this pamphlet, and when the people of* Ireland shall be educated in these matters, steps will doubtless be taken to enforce the public production of the Forest Report that was made to Parliament by an educated expert a few years ago. But let us consider a case where the sources of a river—that should be a source of profit and not a source of danger to a country—are situate in an adjoining country, or in still more distant foreign territory. I contend that the people of such a country has a *casus belli* against the people of the country refusing to protect their hills, mountains, and uplands, which should be the life of the river and not its destruction. Some of the chief sources of the Nile are in the lofty but denuded mountains of Abyssinia; others, again, are in the hills and uplands draining into the Lake Victoria Nyanza, at and near the sources of

the Nile. Now, the wealth, and indeed the very existence, of Egypt and Nubia, as habitations for human life, are dependent upon the efficient condition of the Nile. Is, I would respectfully ask, *any thought* being given to *this subject* by Her Majesty's Ministers and Parliament? A petty dispute—which may at any moment become a danger—is, the newspapers inform us, already in progress regarding the charges to be made for water supplied by the river Nile to native agriculturists in Egypt. Again, the Brahmapútra river—silted up to a very dangerous extent—that has only lately been the cause of enormous loss of property and life in Assam, by its flood waters, has its sources in the foreign territory of Thibet. Now the Assamese might with much reason demand that the Lama of Thibet be compelled to conserve the enormous area of hill and mountain land within his territorial charge. Again, the Kingdom of Turkey might demand that the people of Russia be prevented from pouring the wealth of their country—in the form of soil—into the Black Sea and Sea of Azov. The many sources of the Danube and its many important tributaries also form a case in point, and the hills and mountains and uplands draining into the Danube must be strictly conserved in the interests of the peoples of many separate nations.

We need not travel far to be convinced by the most tangible evidence, of the magnitude of the evil created by the absence of interest shown by successive Governments in this all-important question. We have only to make a tour of inspection of the rivers round about London to be convinced, beyond dispute, of the gravity of the evil. We will find that well within the area of the greatest prosperity the world has ever witnessed, exists unmistakable—let us not mince words when we pronounce it—evidence of a nation's decadence. Evidence that is not to be removed by inditing eulogistic treatises upon our lovely *Oceana*, or by the erection of the glittering splendour of a colonial exhibition. Let us look facts in the face, and let us interpret these facts to our advantage.

If any of you will take the trouble to inspect such a stream as, for instance, the Lea, he will, with a little reflection, be soon convinced of the truthfulness of our statement. Its condition, near London, is well known, and has engaged much attention; but the real cause of the unsanitary state of the main lower stream is likely to be overlooked without an examination of its condition higher up. At Broxbourne, for example, I found, in the middle of June, that there were 3 feet 3 inches in depth—of water in mid-stream, as taken from the bridge at the railway station. This, remember, was in early summer. Judging from the amount of silt accumulated at the sides, some 4 feet, we may take it there are at least 10 feet of silt in the middle of the stream.

Now, a river 60 feet broad, if silted up to a depth of 10 feet,

loses in storage capacity for each mile, 3,168,000 cubic feet. (Thus, 5,280 feet × 60 feet × 10 = 3,168,000 cubic feet). This part of the Lea may be accepted as a favourable example of all the streams in Middlesex and adjoining counties, within from twenty to thirty miles of London.

If, now, we inspect the tributaries and sub-tributaries of the Lea, or of the great Ouse, or, indeed, of the Thames, a worse condition of things will be found; for, in many instances, these are disappearing very rapidly from off the face of the earth. The change that has taken place in these streams—I can aver from personal inspection—within the last three years is positively alarming; and, if we Londoners are to be saved the miseries of a water famine, we shall have to interest ourselves very much more in such matters.

What is the reason for all this? It is certain that had our rivers been silting up for the last hundred years as rapidly as they appear to be now doing, many of those existing would have disappeared. Any one who is in the habit of going for a "constitutional" into the fields about London must have often seen the waterway of former valuable streams dried up and useless; and this in close propinquity to a city that needs every stream and every particle of a stream that Nature can supply. It is, however, equally certain that rivers have in the past cut a way for themselves, grooving out their channels in the most dependent situations. They were then what Carl Ritter calls "working rivers" (*fleuves travailleurs*), and carried their silt out to the sea; now, however, the rivers of England and all civilized countries are becoming more and more silt-depositing and inoperative.

Time was when rivers formed the great carrying channels between country and town, and even between nations. The silt was kept in agitation by the traffic. All this is now changed, as Elisée Reclus* remarks: "No river can now be all that the Nile was to the Egyptians, at once their father and their god, the cause from which sprung both a race of husbandmen, and also the harvest which they gathered on the river mud warmed by the rays of the sun. Another Ganges, with its sacred waves, will never again flow over the surface of the earth, for man is no longer the slave of nature. He can now develop artificial roads, which are shorter and more speedy than the roads formed by nature; and this second and even more vital nature which he has created by the labour of his own hands, surpasses his adoration of that first nature which he has succeeded in regulating.

"Nevertheless, rivers will be more important as servants than they have ever been as gods. They bear upon their waters ships

* The Earth, by Elisée Reclus, pp. 444-5. Messrs. Bickers and Sons, London, 1876.

and the products with which they are freighted, and serve as arteries to vast organisms of mountains, valleys, and plains, which are sprinkled over with thousands of towns and millions of inhabitants. They vivify the earth by their motion, carve it out afresh by their erosions, and add to it by their ever increasing deltas."

To render our slothful and silt-depositing rivers active working streams is the problem before us. As things exist, we find our rivers are either insufficiently supplied with water, or the reverse. The reasons of this are obvious. In order to prevent lateral overflow, we bank the river. This of course tends, in conformity with the law of reciprocity of curves, to divert the force of the stream to the opposite bank, and hence both sides have to be alternately banked up. Moreover, if we bank up without removing the silt from the bed, we raise the level of *the river, and as nature intended it to take a course as dependent* as possible, this, we may be sure, is something that, as the old women say, "*didn't ought to be.*"

Raise the river level, and instead of having the draining of the catchment basin finding its way naturally into the river stream, it will well up in the fields at either side, and the water remaining on the fields will be increased by percolation from the river itself. This means the formation of bog and stagnant water, which in its turn means the growth of rushes, mosses, and inferior grasses. This means inferior forage for our cattle, and therefore a predisposition to cattle disease.

Mr. W. H. Power,* in a recent report issued by the Local Government Board, backed up by Dr. Klein, F.R.S., and Dr. Cameron, has proved that scarlatina arises, in the first instance, from a hitherto overlooked and very trivial vesicular affection of the udders and teats of cows. The origin of many other diseases may be similar ; hence the importance, from a sanitary point of view, of seeing that our river channels are deepened, and that the surface waters drain into the rivers, and are thus sent on to distant destinations, and do not lie motionless and *germ developing upon our fields.*

When flood water becomes stagnant, every kind of evil follows. Dr. MacCabe, the Chief Medical Officer of the Irish Local Government Board, in a recent report upon the state of the river Barrow, showed that when the land is flooded or the subsoil waterlogged by recent floods, the solar heat which should be absorbed by the soil is wasted in evaporating the water, and from this evaporation result fogs along the valleys and cloud-laden atmosphere, which favours a lowered condition of vital power. One of the worst effects, he goes on to say, produced on the health of the inhabitants is that general lowering of vital power always associated with the absence of sunlight. Where

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* *Vide* "British Medical Journal," for May 29th, 1886.

there is an absence of sunlight, a cloud-laden atmosphere and fogs along the valleys, the whole surroundings are depressing, and the result is that the natural vital powers are unable to resist ordinary diseases.

But our rivers are either nearly empty or else over-flowing. So they are, and so they will continue to be as long as we neglect them. Let us, like the priests of Buddha, preserve forests at their sources, and these will afford storage room for the waters of heaven, and gradual filtration into the river stream will be the result. Still more; plant the banks of the rivers, not as at present with stunted unnatural pollarded willow trees, but with fruit trees, with the lovely eucalypti and the towering poplars. This will realise Burns's idea when he thus makes the stream apostrophise the Duke of Argyle:—

> And would my master please
>   To grant my highest wishes,
> He'd plant my banks with towering trees
>   And bonny flowering bushes.

The effect of trees is most important, for by their roots they give firmness and cohesion to the river banks; they direct the in-coming and the out-going water; they thus promote the flow of surface water and subsoil moisture towards the main channel. Then, by their foliage, they form catchment surfaces for the rain and dew, and prevent evaporation from the river itself, and by reason of the dropping off of their leaves and small branches and seeds and seed pericarps they add to and fertilize the natural humus. Many kinds of trees yield to the earth in six years *their own weight* of material; hence the tree is one of the great agents for the prevention of denudation of soil, and the production of valuable manure. The tree is the origin of the stream, and cannot be divorced from it, and the stream is the origin of the spring quite as much as is the latter the origin of the stream.

From all this we learn the important lesson that if we are to have the Rivers and Streams about London maintained in a natural condition, we must re-forest the high lands and re-plant the river banks; and the same applies to all the Rivers of England, and indeed of the entire Empire.

What, as Londoners, we want, is to have Old Father Thames—

> *Though deep, yet clear; though gentle, yet not dull;*
> *Strong without rage; without o'erflowing FULL.*

That the quantity of water falling upon, say, the Thames basin is quite sufficient for the supply of an immense number of people, can be shown by a simple calculation. Thus in Huxley's little work on Physiography,* at p. 45, the matter is very simply put:—"What does a meteorologist mean when he says, in his technical language, that the annual rainfall in London is about 24 inches? By such statement he means, simply, that

* By T. H. Huxley, F.R.S., pages 44 and 45.

if all the rain which falls on any level piece of ground in London during an average year could be collected—none being lost by drying up, none running off the soil, and none soaking into it—then, at the end of the year, it would form a layer covering that piece of ground to the uniform depth of 2 feet. The *year's accumulation would thus form a vast mass of water.* Remembering that an inch of rain represents about 100 tons of water to the acre, it will be found that every acre of land in the metropolis receives during the year, when the year is neither very wet nor very dry, not less than 2,400 tons of rain."

And Professor Huxley goes on to say:—"Looking at the entire basin of the Thames, it may be said that the average rainfall is about 26 inches. Now the area of the basin comprises upwards of 6,000 square miles. Suppose then that we measured out a square space a mile in length on each side, and built *upon this a four-sided tower two-and-a-half miles in height,* which we completely filled with fresh water; this enormous column would represent the quantity of water that falls upon the surface of the Thames basin in the course of twelve months."

These remarks of Professor Huxley are taken from what, of course, is intended by him to be a mere elementary treatise; nevertheless, they are exceedingly interesting and most important. But I feel sure that inquiries and examinations by experts will clearly prove that the surface-soil off a very large portion of the uplands of the catchment area of the Thames has been, by the *unchecked action of rain-water, carried into the river; with the* result that an enormous area of its natural channel is silted up.

This disastrous condition of things—disastrous because unnoticed, for while tens of thousands of pounds are being expended upon the maintenance of roads and railways, scarcely a farthing is being expended upon the natural waterways—has to a very great extent been brought about by grubbing up valuable hedgerows, felling timber, and cutting down precious fruit and other kinds of trees, either to extend the area of cultivation *or to clear the land for building purposes. Now the natural re*sult of the denudation of uplands, the sources of a river, or the sources of many hundreds of tributaries of a river, is, as before mentioned, that the soil finds its way into the channels of the tributaries and into the bed of the river itself.

I find that 3 inches of soil off an acre of land equals 10,890 cubic feet, and 3 inches of soil off only one square mile of upland equals 27,878,400 cubic feet. Now, Professor Huxley states that 6,000 square miles drain into the Thames; and we all know that a very large part of this enormous area is steep upland. *I affirm that the surface soil, by the action of water, has* been cut away, and that this will readily account for the terribly and dangerously silted condition of the Thames.

The Thames, at London Bridge, is about 960 feet broad, and

if we calculate for 8 feet only of silt deposit, each mile of river, so silted, shows a loss, in cubical area of natural river channel, of 45,619,200 cubic feet; in other words, this vast area, which ought to contain water, is occupied by silt.

The fact is, that, *at any cost*, the hills and uplands of every country, whether tropical, sub-tropical, or temperate, must, in the public interest, be placed under forest. Reserves of grass, wood, and timber thus created will regulate the flow of water in rivers and streams, prevent the entrance of silt, provide manure for the soil, fruits for man, fodder for cattle, lessen the disastrous action of extraordinary rainfalls, prevent the extension of bog land, increase the quantity of subterranean waters, retain by the action of capillarity the subsoil waters near the surface, provide timber and fuel, lessen the action of destructive winds, be the natural means for replenishing the waters of lakes and wells, lessen the bills of mortality; and, in fine, bring about those beneficial results for countries and peoples that the inspired poet desired when he wrote :—

> "Let your plantations stretch from down to down,
> First shade a country, and then build a town."

The problem for the intelligent community is, of course, how to so utilize the great downfall of rain water that it will prove most conducive to the requirements of the population. And let there be no mistake about it, if we allow the rivers and their tributaries to silt up as they are now doing, our water supply and our agricultural wealth will proportionately suffer.

Our agricultural industries are very depressed, and this depression leads to the neglect of the smaller streams coursing through the fields, the farmer not having the capital to spend upon them as heretofore. These, therefore, get neglected and consequently block up, and they in their turn lead to the blocking up of others, and so it operates until the rivers themselves silt up and become useless.

A telegram was but a few days ago received from India stating that 20 miles of railway were washed away in one night by flood waters in the Punjab, the result of but a few hours' rain. The word Punjab signifies "the land of five rivers"—the Jhelum, the Chenab, the Ravi, the Beas, and the Sultej, the last and southernmost of which was the limit of the expedition in ancient times of Alexander the Great. All these five rivers are silted up, and can hardly be said to hold water. The melancholy but impressive fact stares us in the face that there is scarcely a portion of any country in the world that is not now injuriously affected by its *normal* waterfall.

In vain are rivers artificially banked at an enormous and useless expense; they are unable to hold the normal rainfall, and the tributaries being blocked out by this interference, destructive floods necessarily result.

The poet Burns wrote :—

> Still o'er these scenes my memory wakes,
> And fondly broods with miser care,
> Time but the impression stronger makes
> As streams their channels deeper wear.

But Burns therein considered the natural action only of flowing water, and evidently though an agriculturist, was not aware that long before his day the streams and rivers of his country had deepened themselves to their required depth, and were, when he wrote, in progress of being silted up.

The streams and rivers of countries are no longer *ever* a source of welfare and a profit to countries and peoples as they should be ; but, on the contrary, are now a source of constant trouble, expense, and danger to property and to life.

This subject is thoroughly understood by the people of India, who have forced upon the Supreme Government the necessity of appointing an independent commission—now sitting—of inquiry.

England complains of not being able to elicit from the natives of India what really are their wants. In this particular, however, no such excuse for misgovernment is available ; for the Brahmins have peremptorily demanded that the vast areas of hills and mountains and uplands, the sources of the streams and rivers—the natural wealth and prosperity of the country—which the British Government, in ignorance, leased for cultivation, should be re-acquired by the State by purchase, and replaced under forest.

And here I would emphatically state for your consideration, that the same condition of things which they so powerfully describe, exists not only in India but in England and Wales, in Scotland, and in Ireland, and indeed in all parts of the world with which man has injuriously interfered.

What native opinion is on this subject will be seen to be absolutely unmistakable by the Appeal of the People of India, headed by the Brahmins, to the Supreme Government. And should the day of reckoning ever come upon us, which God forbid, in connection with our lack of duty to the rivers of India, let no hypocritical excuses as to the unfathomable nature of the native mind be forthcoming, when there is on record such documents as this.

The Appeal runs thus :—"The inevitable consequences of the destruction of our natural forests have overtaken us ; our rivers and streams have been silted up, the fertility of the soil on the plains has decreased, the supply of firewood has diminished, the number of agricultural cattle is yearly decreasing, manure has become both scarce and dear, wells have dried up, inundations have been more frequent, and loss of life and property great. Every little shower causes inundations, and after the waters flow over they leave a thick sediment of silt, which

fills up the watercourses and impoverishes the soils thus deprived of their top layer of natural humus.

"The floods near Nowsaree and the Khandesh rivers (of which we heard only the other day, when the water rose to a destructive height after a rainfall of ten hours' duration only) have become the normal type of our present river system. The destruction caused by the rivers Krishna, Kohina, Tapti, Nerbuda, Girna, &c., has inflicted infinitely greater loss on private and public property in a single year than the whole revenue which Government has derived by leasing the hill sides for cultivation could defray.

"There can be no doubt that we should be untrue to ourselves if we did not reiterate our convictions that far more than railways and irrigation works, far more even than our schools and police organisations, the weal or woe of this country depends upon the use we make of our forests.

"Nature has been defied and trifled with too long, and now she is demanding retribution and scourging us with plagues because, by our own acts, we have brought our fairest regions to barrenness and decay.

"We wish the Government of India to appoint a competent Commission to deliberate on these points, and to determine what practical steps should be taken to prevent the further silting-up of the beds of streams, rivers, and inland artificial and natural lakes, and for the perennial replenishment of our wells and subterranean waters."

So much for the Brahmins of India on the subject. The Commission, as before remarked, is now at work.

It were well indeed had we taken to heart and learned a practical lesson from the words of our own Divine Book, ere we commenced to civilize and convert a people who worshipped their forests, their groves, their streams, and their rivers:—

"The Tree of the Field is Man's Life."

The following is a classification of our Rivers in England and Wales, with their mileage :—

	Miles.
Of First-class Rivers—such as Severn, Thames, Mersey, Wye, Trent, Usk, Ouse, &c., &c.—without their Tributaries, there are in length,	2,670
Of Second-class Rivers, being the larger and more important Tributaries of the First-class—such as the Lea, Cam, Derwent, Little-Ouse, &c., &c., ...	1,660
Third and Fourth-class Rivers, not being Tributaries of the First-class, but having direct flow into Ocean water, ...	1,510
Fifth-class Rivers, being the smaller Tributaries of the First-class, ...	3,900

Sixth-class Streams, being the larger Tributaries of Second and Third-class Rivers, ...	5,990
Seventh-class Streams, being Sub-Tributaries,	37,750
Eighth-class Streams, about, ...	150,000

That is to say, we have in England and Wales alone some 200,000 miles of river and stream channel, the greater portion of which our masterly inactivity has been improving off the face of the earth!

We have shown that with 10 feet of silt in a river 60 feet broad we lose 3,168,000 cubic feet of the river's normal storage capacity per mile; in the case of the Lea, the silt occupied three times as much space as did the water of the river. In times of heavy rain, therefore, such a river, if cleared of silt, would hold three times more water than it did in its silted condition, before it could possibly overflow.

This calculation for one mile only of river, and this a very small one, serves to show very forcibly why it is that when heavy rains fell last winter so many of our farmers, and of our railway companies, suffered considerable losses owing to the flooding of fields, tunnels, and even dwelling houses.

As a friend writing to me well observed: "It is absurd to cry, '*God save Ireland*,' or '*Parnell save Ireland*.' Scientific education, with work—scientifically performed—will alone save the people of that country, and of many other countries, from poverty, and consequent crime, degradation, and disastrous anarchy."

Let us acquit ourselves like men, and be strong; strong and determined to use obvious and plainly evident means to maintain the soil of the country in a condition fit for cultivation. In order that this may be done, appeal must be made to Government for a Forest Act, and we must point out the necessity for immediately establishing a Department with power over our woods, forests, hills and uplands, and rivers, similar to that in India and other countries, but possessed of greater powers than the Indian Department has hitherto had.

It is ridiculous to cry out about the expense; the goose that lays the golden egg is not to be put out of the way for want of a "ha'porth" of corn; nor do I know of any more appropriate work for our prison labourers than would be afforded by the dredging of our rivers, and the carting away of this valuable material to the fields. Anyway, it is childish to propose emigration as a remedy for distress, at a time when our fields lie neglected for lack of manure, which chokes our rivers in millions of tons. And it is heartrending to observe that while this necessary and remunerative work is to hand the inmates of our prisons, poorhouses, and asylums are employed in competition with honest industrial enterprise. The problem before us is to find sustenance for an ever-increasing population; the country

has to support a present population of over 35,000,000, in contrast with one of 11,000,000 in the beginning of the century. It is said that the truest philosopher is he who can make two blades of grass grow where one grew before. We can show how easily this is to be done.

Let any of you observe in the railway cuttings the slight depth of surface soil that is left for tillage upon our fields, and remember that as time goes on this gets less and less, owing to the denudation effected by rain and by injudicious treatment of the land. Remember also that this valuable humus is being washed off the ground and carried by the action of rain water into our river channels, and that unless it is dredged from these and carted away and distributed upon the fields, ultimate sterility of soil must result.

It will not do to heap up the refuse material upon our river banks, and leave it there, as has been done along the sides of the Lea, till the next downfall of rain washes it back again. No, no, it must be distributed freely upon the fields from which the rain has washed it; and in this way two blades of grass may be made to grow where one grew before.

If we can find money for Egyptian campaigns and for expeditions to Burma, we surely can find the capital needed to regenerate and revivify the uplands, fields, and pasturages of "Merrie England."

Just so; and we cannot obtain the fruits of our labour upon our fields unless we protect the soil and expend labour upon the water-ways of our dear old country.

But there is another aspect of the question. That great and all-powerful agent, electricity, is placing all countries and peoples upon a footing of equality. The power and future greatness of a people will, in consequence of this, be determined, in a great measure, by the distribution and gross amount of its water power.

England is singularly well circumstanced to compete with other nations in this respect. With Wales she possesses, as we have shown, some 200,000 miles of water-channel, the water force of which may one day be employed in developing electric power.

But if we neglect our water channels and our forests it will be but a question of time when the spectacle is presented of Macaulay's New Zealander seated on London Bridge calmly beholding the ruins of this mighty Babylon.

There is yet another aspect of the question. The wear and tear of an increasing population sets free a mass of detritus that is being carried away by air and water, and it is evident that this must lead to an increased accumulation of solid material in our river channels. Just as increased expenditure of time and money is required with an addition to the inmates of a household, so is improved organization and additional Governmental

expenditure required in order to free the outlets of waste when a numeral increase of the population takes place.

The task is a mighty one ; but the expenditure, if judiciously undertaken, will amply repay itself, and an immediate return may be looked for in the happier and more prosperous condition of the country. If the Augean stables are to be cleansed, let not the *fiat* of impossibility go forth, but let us set about the practical accomplishment of a purpose that will secure for us of to-day the gratitude and blessing of our children, and, in the future, of our children's children. Let a policy of dirt and slothfulness and ignorance—for it is nothing else—give place to one of cleanliness and activity, and of *power:* this and this only will bring happiness and prosperity.

One cause at work the present day in contrast with the past, powerfully operative in setting free detrital material, is our *network of railways. It is ridiculous to suppose that* we can have the country interspersed with hundreds of lines of railroad, and can drive ponderous coke and coal burning engines, pulverising material and distributing dust in every direction as they roll along with lightning speed hither and thither over the surface of the country, without an injurious influence being exerted upon water channels.

This is a point that has been insufficiently dwelt upon, and that most certainly is worthy of consideration, because it lends weight to the argument that our streams are silting up more rapidly now than in former days.

Almost every old fisherman can testify to the disappearance of streams that in the times of his boyhood afforded him many a healthful and remunerative day's sport.

If we set matter of any kind in rapid motion, wear and tear will result ; and this must obviously be associated with the dispersion of material particles through the atmosphere ; many of these must, in the nature of things, be washed into or blown down upon our water surfaces, and hence an addition will be made to the ever accumulating silt.

More than this, railways exert a most pernicious influence upon the free flow of water to the river channels. For in crossing the catchment basins of rivers, they form impassable banks that impede the flow of surface water, and thus shut off the water of extensive areas that formerly constituted a source of supply to the river.

All this goes to show that the system of management of the country—if we can be said to have had any system—which may have been tolerable in the past, may, for very cogent reasons, be wholly unsuited for the requirements of a generation of matter-agitating beings like ourselves. And it affords a complete answer to those who are ever ready to argue that as our rivers needed no care in the past, they can be left equally uncared for in the future.

I have already stated that the total aggregate length of river and stream channel in England and Wales is upwards of 200,000 miles. This does not include the lengths of lakes, which natural high level basins are frequently the source of important rivers, and, along with our many artificial canals, require most special attention. And I have stated, and am prepared to prove, that the greater part of the original river and stream channel has silted up. Now, to set to work and to deepen this enormous length and breadth of channel, will not only be an exceedingly expensive work, but will give employment to every available working man in the United Kingdom. Yet we learn that "during the six months ending June 30th, the persons of British origin who left the United Kingdom for places out of Europe, numbered 112,227." But men and money must be forthcoming for this work, in this and in every other country *in the world; for the same melancholy and dangerous condition* of things exists in every country.

We know that, through ignorance, the willows which used to line the banks of our streams in countless thousands, have either been destroyed or ruinously pollarded—and thereby diseased—to death. The power of capillarity of this family of trees is simply enormous.

> The torpid SAP, detruded to the root
> By wintry winds; that now in fluent dance
> And lively fermentation, mounting spreads
> All this innumerous coloured scene of things;

favours the flow and storage of underground moisture, thereby fertilizing and improving the soil. Landholders might now set to work and replant the willow, and cherry and other edible fruit trees, along the upper banks of their river lengths.

This will at once, amongst other things, produce revenue, increase the level of the upper banks of the rivers, give valuable edible fruits for consumption, provide timber for building, and do away with the necessity for exporting English gold to foreign countries for fruits which can be readily grown at home, with *lasting benefit to the country. Quite recently, the Daily Telegraph* stated that "as many as ten thousand baskets of cherries were landed from Holland in one day, of the value of three shillings and fourpence a basket." Here then is a loss of £1,700 per day on these small importations alone, while a vast portion of the produce so imported finds its way into cesspools that are permitted to pollute our rivers and streams.

While the value of land in this country is annually decreasing, and numerous farms remain unlet; while floods in every country are inundating lands, ruining crops and destroying men and cattle;—an instance of which occurred recently in Hungary, the rivers Temes and Bega having inundated a large district and destroyed two villages;—we find that the Government of Spain is proposing to raise money for monarchi-

cal and ecclesiastical expenditure by the sale of her natural forests.

The statements made, though applicable to all parts of our Empire, are especially so, be it noticed, to those least securely held; namely, Ireland and India.

The condition of the river Barrow, in Ireland, has lately formed the subject of inquiry, and the estimated expenditure required to restore it to a navigable and efficient condition amounts to over £474,000, and this it is proposed to fix upon the owners of the adjoining soil. But it is evident the question is really a national one; it is not the Barrow only, but all the rivers of the Empire that cry aloud for attention, and the money needed for the work must come from the entire population.

It will not do to undertake the work in a halting, fitful, and piecemeal fashion. An extensive and well-directed scheme ought to precede the inauguration of an executive Department, having power over our entire *Fluviana*—our EMPIRE OF RIVERS.

SISSU PLANTING IN THE GORAKHPUR FORESTS.

As the sissú plantations in the Gorakhpur forests are pretty extensive, and have been very successful, a description of them and the method of planting will no doubt be acceptable to the readers of the "Indian Forester."

Locality.—The situation of the ground selected for planting was a tract of grass land on the outskirts of the Sonari forest at Sukhwi, North Gorakhpur; it lies between two rivers, the Rohin and Pyas, which are at this part, from one to one-and-a-half miles apart; both of them have their source in the Nepál hills, and both overflow their banks here in the rains; both are very winding, and their beds have little slope, their banks, which average about 15 feet high, are in general covered with jaman trees.

Character of ground.—The surface of the ground undulates, and *in consequence of this, the low parts are covered* with water to a depth of 5 feet in the floods; the water marks on the trees are very distinct, showing that the water remains at that height for some time. In the rains of 1883, the spill water of the great Gandak got into the district, and half of the plantation was under water for two months. There are a number of old river beds, all over the tract, these have no outlet, the water in them is from 3 to 5 feet deep in the cold weather, and about 10 feet in the rains. These beds are filled with jaman trees growing in the water, and on the banks, scattered all over *the ground, are a few good sized trees of* padal, simal, haldu, and a few other kinds. The surrounding forests are of sál, and the fact of these grass covered tracts occurring in almost pure sál forests, shows that they are not adapted for natural

forests; most likely this is owing to their being frequently under water. The well on the highest part of the ground, where the forest chauki has been built, has in the cold weather the surface of its water 18 feet below that of the ground, while in the rains it rises to within 2 feet of the ground.

Character of soil.—The soil is yellowish in colour, and is a mixture of clay and sand, in which the clay seems to predominate; it is good brick earth, in rests on a substratum of sand, the sand is found at various depths, but the average is about 15 feet.

Why sissú selected.—In the Gorakhpur district sissú is rare, only on the sandy islands in the Gandak, which borders the district, are there any quantity to be found, and as this wood is the best for general and agricultural purposes, planting it will not only benefit the district, but benefit the forests also, for a well grown sissú tree 30 years old is worth Rs. 30, for timber and firewood.

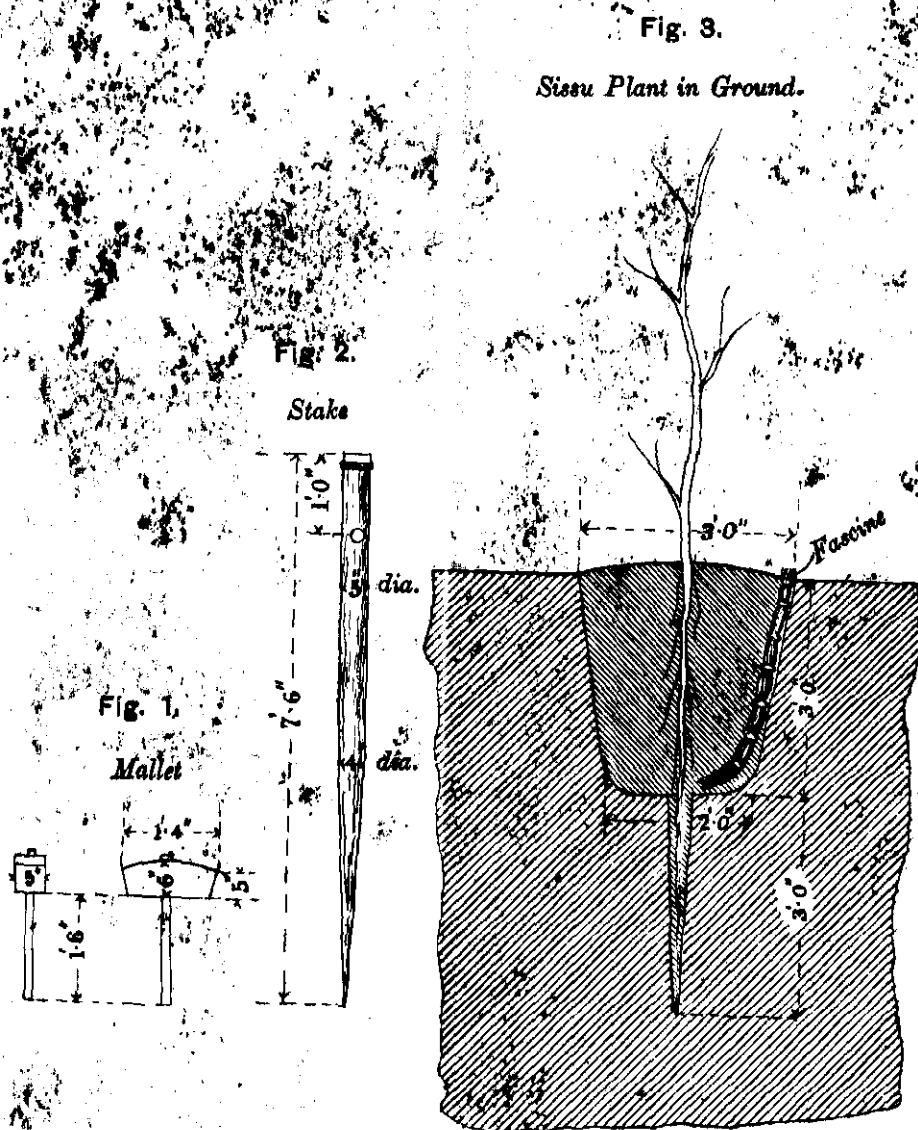
Nursery.—At first, the plants were carted from nurseries in Rámgarh, a distance of 60 miles from Sukhwi, afterwards the plants were raised at Sukhwi itself. The ground for the nursery is well dug up for 2 feet deep, and ridges are thrown up 2 feet apart centre to centre, the seeds, selected from good healthy well grown trees, are then sown pretty thickly on the top of the ridges, and covered with earth in the usual way. They are sown in March, April, and May, and are regularly watered till the commencement of the rains, at the end of the rains, the plants will have the tap root up to 6 feet long. Some that were being planted in February last were measured as they came to hand, they were sown in May 1886, but their growth had been somewhat retarded owing to the nursery being under water for sometime in the rains. These are their dimensions:—

Dimensions of plants.

	Length of tap root.		Diameter of stem at ground.	Length of stem.	
	ft.	in.	in.	ft.	in.
1 plant	5	7	$\frac{3}{4}$	4	9
1 ,,	4	9	$\frac{5}{8}$	4	4
1 ,,	4	5	$\frac{5}{8}$	2	11
1 ,,	4	5	$\frac{1}{2}$	3	11
1 ,,	5	0	$\frac{1}{2}$	3	3
1 ,,	4	$6\frac{1}{2}$	$\frac{5}{8}$	3	$1\frac{1}{2}$
1 ,,	4	2	$\frac{5}{8}$	2	11
1 ,,	4	3	$\frac{1}{2}$	3	9
1 ,,	2	$9\frac{1}{2}$	$\frac{1}{2}$	2	6
1 ,,	3	6	$\frac{5}{8}$	4	6

Preparing the plant holes.—These holes are 3 feet diameter at the top, 2 feet at the bottom and 3 feet deep; they are dug before-

SISSU PLANTING IN THE GORAKHPUR FORESTS.



Litho. T. C. Press, Roorkee. THOS. D. BONA, Supdt.

hand at the regular distances apart, the tool used in digging them is the ordinary phaorah, or kodali, as it is called in the Gorakhpur district, the handle is used short, 18 inches over *all*; it might be thought at first that the men would find some difficulty in digging a hole this size, but it is surprising to see how deftly they clear out the bottom of the hole, they do it apparently as easily as digging in a trench of the same width.

Fascines.—A fascine of coarse grass 4 feet 6 inches long and 4 inches diameter, tied together with grass every 6 inches, is prepared ready before the planting commences, this is used to conduct the water to the bottom of the hole as shown in *Fig.* 3.

Tools.—Besides the phaorah, the only tools required are the stake and mallet. The stake is made of sain or asina (*Terminalia tomentosa*), of the shape shown in *Fig.* 2. It is 7 feet 6 inches long, 5 inches diameter at the top, and tapers as shown. The top is bound round by a rope made from the Bauhinia creeper (*Maljhan*), the rope is put on wet, and on drying, it shrinks and tightly binds the top of the stake, and helps to keep it from splitting: one foot from the top a hole 2 inches diameter is bored through it. When the stake has been driven to its full depth, a bar is placed in this hole, and the stake turned round to loosen it and enable it to be drawn out easily. The mallet is as shown in *Fig.* 1; it is the same as the mallet used for driving in tent pegs, and is made of sál, as this is the wood easiest procurable: sissú makes a much better mallet.

Digging out the plants.—This is the most difficult of the operations connected with the planting, as it requires men trained to do it carefully, so that none of the roots are damaged. At Sukhwí the operation commences by the digging of a trench 6 feet deep at the side of one of the ridges on which the plants are, the earth is then removed carefully from the roots, and as each plant is taken out a stout stem of grass is tied to the root and stem, and the plant laid on some damp grass on a stretcher or hand barrow. When enough are dug out, the plants, covered with more damp grass, are carried to the holes prepared for them.

Time for planting.—As stated before, the planting was done at first in the rains; the success was everything that could be desired, but as the forests during the rains are unhealthy, and as it was found that the planting could be done as well in the cold weather, it is now done during the end of October and in November, December, January, February and the beginning of March.

Method of planting.—The holes being dug, the fascines made, and the plants carried to the holes, the planting commences. First the stake is taken and thrown down the hole, striking the bottom of it fairly in the centre, it is then driven down by the mallet, till it is 3 feet below the bottom of the hole, a bar is then placed in the hole at the top of the stake, and the stake is

twisted round till it is loose and can be easily drawn out. The plant with the root tied to the stem of grass, is then lowered into the hole made by the stake, and a stick is placed at the bottom of the large hole, and inclined towards the stem of the plant, both are held together by the hand. The stick forms a rest and enables the plant to be held firmly. The fascine is then placed at the side of the hole, *see Fig.* 3, and the earth is then carefully filled in. When the hole is two-thirds full of earth, two gharas full of water, are poured on it, this consolidates the soil around the roots of the plant, the stick is then drawn up, and the remainder of the earth filled in; one ghara of water is then poured on the top of the earth and another down the fascine, this ends the planting.

Watering.—By means of the fascine the water is delivered 3 feet down from the surface of the ground; during the cooler months one ghara full of water is poured down the fascine once a month, in the hotter months once in three weeks; this is continued till the rains commence, after which no more watering is done. The gharas are about a foot in diameter, and are spherical in shape.

Growth.—The grass grows very rapidly and thickly during the rains, and the plants have to contend against it. On the higher lying ground they soon get above the grass, but on the low-lying parts the flooding keeps back the growth of the plants, while it favours that of the grass. The loss here through plants dying is estimated at 20 per cent. before they become finally established, while on the higher ground the loss is only about 4 per cent. The height of the trees are much the same for those planted at the same time, but the diameter varies a good deal. Of those planted in July 1881, the following are the heights and girths of some of the largest:—

Height.	Girth 1 foot above ground.	Girth 3 feet above ground.
feet.	inches.	inches.
43	38½	32¾
45	36	32
44	34½	30¼
45	33¾	30¾
45	31¾	29
43	30	25
48	26½	22½

This is very good growth for trees 6 years from seed.

Character of the wood.—The value of sissú depends on its heartwood, which is very like rose wood, it is very strong and

hard, works well, and takes a beautiful polish. Whether there is any heartwood or not in these young trees cannot yet be ascertained without cutting down some. Search was made to see if there were any dead and dried up trees that could be cut down and the section examined, but none could be found; this says a *good deal for the health of the plantation.* One tree of small girth was blown down at the beginning of the rains of 1886, its height was 35 feet and girth 20 inches. A section of this when polished showed clearly 15 rings; the tree was 5 years old, so each year has three rings. These no doubt correspond to the spring rains and autumn growths, and show how fallacious is the system of estimating the age of a tree by the number of rings in its section. Botanists, however, are now beginning to recognize this fact. The wood of this small tree was hard and firm, but it had not become very dark coloured, though the *exuding of black pitch from a crack in the centre* showed that the transformation was beginning.

Cost of planting.—The digging of the plant-holes is done by task work, one man digs 20 holes for 2 annas, but when the earth is very hard only 16 holes are done at that rate. The digging up of the plants, carriage to site, making the fascines, planting the trees, and watering them at the time of planting, costs just double this, that is, the number of men who will dig 100 holes, will only dig up the plants for and plant 50 trees in the same time.

Up to date, the total cost of one tree established has been one anna. The trees have been planted at three different distances apart; at first they were put in at 15 feet apart, then at 30, but now 21 feet apart is being worked to. The distances give respectively 193, 48 and 100 trees per imperial acre.

Area planted.—The following is the area planted during each year. Commencing from—

			Acres.	
July 1881,	..	..	20	15 feet apart.
"	..	..	60	30 " "
1882,	..	..	220	30 " "
1883,	..	..	250	21 " "
1884,	..	..	800	21 " "
1885,	..	..	450	21 " "
Estimated 1886,	..	..	280	21 " "
	Total,	..	2,080	or $8\frac{1}{2}$ square miles.

The entire plantation is divided up into suitable blocks, by roads 20 feet wide; these are kept clear of grass, and act as fire lines; the trees on the sides of the roads are planted closer together, *to kill down the grass there and to give plenty of shade.* The 60 acres first planted at 30 feet apart, have had tún and khair planted between the sissú; the tún has done as well as the sissú, but has suffered much from the nilgai eating it.

Financial results.—It is yet too early to get any return from the trees, but there has already been a large sum realized from the sale of grass for thatching purposes. The preserving of the tract from fire has increased the growth of good grass, and it now brings in Rs. 2,000 per annum, though formerly the grazing dues did not average more than Rs. 50 per annum. As the trees grow bigger, the grass will be killed down; there are already signs that this is being done under the trees first planted.

Conclusions.—This plantation of 2,080 acres, or 3¼ square miles, is not a small struggling affair, but a large successful plantation. Captain Wood's theory of planting was that the plant should have its tap and other roots entire; that it should be planted in a good mass of loosened earth; and that the water should be delivered at the roots, some considerable distance below the surface of the ground. When the plant has its roots entire, it can draw nutriment from a greater area of soil, and when a good mass of the soil is loosened and mixed with the surface soil, the lateral roots can more easily penetrate it, and so get better nourishment. The tap root going well down, makes the tree firmer in the soil, and by getting into a damper region keeps the plant alive; if accidentally the giving of water to it is missed at any time, the sub-soil watering gives the water at the very place where it is wanted, and as none is put on the surface, the soil there keeps in good condition for the influence of the air to act on it, and the water being given in such a favourable place, makes a few waterings only necessary in the dry weather to keep the tree growing vigorously, till the rains come on. That this system of planting has to do with the quick growth of the trees, can be seen on comparing those in a plantation on somewhat similar land at Mundowlia, 12 miles south of Sukhwi. There the trees are 13 years old, the area is about 1¾ acres, they were planted in the ordinary way, and were watered constantly at first, and though the cost has been very heavy, yet the largest tree has a girth of only 38½ inches, at 3 feet from the ground, only a little larger than the ones of 6 years old at Sukhwi, while a great number are much smaller than the smallest at Sukhwi of that age.

The details of the different operations necessary to carry out Captain Wood's theory have been carefully and zealously worked out by the Assistant Conservator in charge (Mr. Alex. Campbell) and the Ranger (Roghá Náth Pathák) by his attention and good arrangements for labour has contributed greatly to the success.

DATES IN JEYPUR.*

I AM extremely glad to hear that the Durbar have sanctioned

* Copy of a letter from Brigade Surgeon E. Bonavia, dated England, 18th January, 1887, to Lt.-Col. S. S. Jacob, Exec. Engineer, Jeypur.

half a ton of date palm seeds. Your plan is a good one, that is, offering an inducement to the people for growing and taking care of them. You will have been a great benefactor to the Jeypur State. You should, however, I think, keep a nursery under your own eyes. Seeing is believing, and natives are slow in believing and caring about results they have *never* seen. Like children, things must be done for them until they taste the advantages, and then no one is quicker in taking up a thing. As to procuring the seed, there are many ways. Either applying to the Government of India and they will get seed through the Persian Gulf Resident. They have lately sent ten maunds of seeds and 230 offsets of four of the prime varieties to the Central Indian Agency and a similar amount to the Punjab Government. Offsets should reach you in October, while seeds need not reach you till February, and this will give more time for collecting the seed. Seed is not utilized in the Gulf, as they have innumerable ready-made offsets of the *best and most valuable varieties*. So that, in the Gulf, they have some difficulty in sending seed without due notice. Write now and get what you can through Government. Then you might write to the Political Resident, Persian Gulf at Bushire direct, and also to Messrs. Gray, Mackenzie and Co., Busrah, for seed. The kinds most valued in the Persian Gulf are "Hellowi," "Khudrawi," "Zehdi," "Samran." The latter, a hardy tree with excellent fruit.

Hallowi exported to Europe are the most highly priced and esteemed, because of flavor, and "because they do not get wormy when packed in boxes," and Zedhi fetches the highest price in Bombay. Then Mr. Duthie of Saharanpur may be able to help you with imported seeds. He has undertaken large plantations of nurseries of date trees of all sorts and from all countries. Then Mr. Ridley of the Horticultural Gardens, Lucknow, may be able to help you with seeds of his acclimatized varieties, both of offsets and of seedlings. He can send you the fruit before it ripens or as it is ripening. Before fully ripe the seeds germinate equally well. Seed sown in winter may not germinate till February, and that sown in February will germinate in a fortnight or so.

Further, at the suggestion of the Director at Kew, I wrote to Sir R. Lambert Playfair, H. B. Majesty's Consul General, Algiers, and explained to him our Indian wants, as they thought there were great difficulties in sending seeds and offsets from the south of Algeria; they have saline oases, where date trees are grown, and nothing but date trees thrive in that soil! I heard from Sir Lambert yesterday. Hear what he says: "I only returned from the Djerid (in Tunis) a few weeks ago. I superintended the selection of the date seeds in person, and am about to return to Tunis in a few days." The seeds have been sent to the Government of India. Apply for a portion of them. The Djerid variety of dates is said to be the finest in the world.

He adds: "Really there is no necessity of sending offsets, although from what you say, there would be no difficulty. Seeds are sure to germinate, and the experience of the Arabs here (Algiers) is that the fruit of seedlings is quite as good as that of trees propagated by suckers. The only difficulty is that seeds give a large proportion of males than *needed*." Please note the above underlined word. Never believe what they say in the Persian Gulf about seeds. Seedlings in Oudh have produced fruit equal to suckers! I sent a fine collection of date fruits from seedlings to Kew just before leaving India. In the Persian Gulf, they despise seeds because they don't need them, in the same way that in India good mango stones are despised, because they have any number of grafts of the best kinds. There in Egypt they have upwards of 50 varieties of dates. Some grow in dry places, others in damp with a good deal of cultivation. As I crossed the Isthmus of Suez I saw date trees of which fruits had been recently gathered with their roots in *water*. Everywhere water was within one foot of the surface; the inundation apparently had just been receding. The best Egyptian date is a small one and is like sweetmeat. Write to any of the Egyptian Canal Officers (all of them Indian Canal Officers), or to the British Consul in Alexandria, or to any English Officer you may happen to know there. You cannot have too many varieties to begin with, and import a lot of seed every year. When the Persian Gulf people know that seeds of good dates are wanted, they will collect and keep them every season.

From September (ripening of crop) to January, they can collect you maunds of seed every year. The Director of Kew, writing to me recently, says: "I am sure the enterprise (introduction of date trees in India) you have undertaken is a sound one, and I have done my best to back you up. You have set the ball rolling, and it must now rest with the botanical officers in India (and others) to keep the game going." Sir Lambert Playfair is an old Indian officer and a good gardener himself, and will help in the enterprise with great pleasure, so write to him. "Although," he says, "I have already sent off the first supply *enough to plant half India*."

He, however, may have forgotten that India is overrun with goats and cattle, which in dry seasons eat up *everything* they are allowed to, and natives are apt to leave everything too much to God! So for the next 10 or 15 years, pray never relax your efforts to *obtain seed* and to *plant* and to *protect*. You will be the great benefactor of Jeypur. The thing is not to be done at once, but steady persevering work is required and an indomitable *will* not to be *beaten*. The thing is to be done without much trouble. In my opinion seed is the best for general use. *The more the males at first the better*. Until Natives understand the tree as well as they now understand the wheat growing, then of themselves they will make plantations of offsets of

their best females only, and artificially fertilize with pollen of a comparatively *few* males. There is time enough for that. What is wanted now is to get the seed, sow it, nurse the plants, plant them out in plantations and protect them till they are out of reach of harm. This is to be done every year until all spare land at Jeypur in every village is *filled*. The cultivated trees produce the best and finest fruits. Offsets being expensive should, I think, be limited to nurseries and plantations at head-quarters. In the hot weather, they will be given frequent watering to grow rapidly. I hope you may also induce the other States of Rajputana to follow your example. If you could lithograph this letter, you might circulate it among them, *privately*. I think if the matter were taken up by the whole of Rajputana, in 10 or 15 years, that tract of country would be a different country, and its saline oases are favorable to date tree growing.

There is another plant which I wish now to recommend *strongly* to your notice and care, namely, the *European Prickly Pear tree* (a Cactus). You have hedges of the wild varieties. Nurseries of the latter might be made and European varieties grafted on the wild ones. It grafts with the greatest ease, and might also be raised on its *own* roots, like the wild ones, with a certain amount of care. For rough rocky soil, where water can be given to the trees, round tanks, &c., the cultivated variety produces admirable and delicious fruits. In Malta, the best varieties are to be had—to be obtained through Government. They are usually grown in *private* gardens, *viz.*, the *white*, *red* and *yellow* fruited varieties. But it is grown largely in Egypt, Sicily, South of Italy and in Spain, and probably all along the Mediterranean. Some time ago, I *urged* the Madras Government to give it a trial. They have done so, and introduced it into Bangalore and other places. In South India, the wild prickly pear grows everywhere, and hedges are made of it; it bears a small red and rather tasteless fruit which natives eat. Mr. Steavenson, the Honorary Secretary, Agri-Horticultural Society, is very keen on *prickly pears*, and may send you some of his imported kinds; also Superintendent, Mysore Government Botanical Garden, Bangalore; also any English official in Egypt. The cuttings are bat like pieces of the stem; should reach you in October *after* the rains, as too much *before* rooting might rot the soft cactus substance, but perhaps in Jeypur, where you may not have much rain, the rainy season would be preferable. Try to get them *now*, in the *rains*, and also *after* the rains. Your Jeypur stony soil, with a little digging, manuring and watering to give the prickly pear trees a start, might prove admirably suited to this plant. Udaipur and Ajmir, besides Jeypur, have taken date offsets, also from Saharanpur. You can get seeds of good Mooltan dates and also of Sindh dates from Karachi.

E. BONAVIA.

A NEW SPORT.

THERE is a constant cry from our friends of the rod and gun that sport is overdone, that there is little or no game left except for those who are fortunate enough to have time and money to spend in going miles and miles a-field. Any particulars of a new sport will I am sure be welcome; gird up your loins then brother foresters, surfeited with the slaughter of countless tigers, bison, &c., here do I gratuitously offer you an entirely new sport in no inaccessible region! As a rule the sportsman who is fortunate enough to find some nice little corner where game is plentiful and big bags of daily occurrence, is most careful to keep this sacred spot a secret from even his most intimate friends, well he knows the result of letting the cat out of the bag. But I will let no such selfish feelings deter me—come sportsmen *(foresters or no), come all who can, bring your friends* if you like (in fact I would advise you to do so), and enjoy the sport whilst you can. At present the game is unprotected by any Game Laws, any one is at liberty to roam at will from one end of the country to the other; but in two or three years it will be protected, not on account of its scarcity and the risk of its exte mination, but because of its utility to mankind—for much the same reason as the elephant is now protected in India. At the moment at which I write the game is in such abundance and so destructive in its habits that no protection is thought of.

The country which this beast affects is one of the most fertile; it is well watered by one of the grandest river systems in the world; it is peopled by one of the most lazy and easy-going of races; provisions of all sorts are obtainable at not too exorbitant rates; labour, although dear, is not extravagantly so, the climate, although trying to Europeans during the hot weather and rains, leaves nothing to be desired from December to February. It is essentially a country of forest and stream, the timber that it produces is far-famed, and when the Forest Department shall have spread its branches over this network of streams and ridges the Chancellor of the Exchequer's post will become a sinecure.

"But where is this Elysium, this happy hunting ground?" ask our sporting friends. Wait a minute, I must tax your patience a little longer with a rough description of the animal's habits so that you may know what to expect, and in what sort of battery to indulge.

The jungle in this Elysium is very thick, and the game is almost invariably met at close quarters, so that a rifle warranted to hit a postage stamp at 1000 yards six consecutive shots (if held straight!) is not an absolute necessity. The species is gregarious, and the animals go about in herds numbering from five to several hundreds; they are most pugnacious, and if come upon suddenly will almost certainly attempt to "go for" the

intruders. But they have no pluck, and if worsted at the first onset will generally turn tail and bolt off into the jungle. They are not very large, weighing on the average about 120 lbs., so a heavy bullet is not required. The only weapons I should advise are a ·44 Winchester Repeater and a ·455 Revolver to take Government ammunition; these should both be carried by the sportsman himself on all occasions.

I am sorry to say that personally I have not bagged a single head yet, but I have seen the beasts both dead, wounded and in captivity. Forest officers in this Elysium are usually so hard worked (I don't mean for a moment that we have a monopoly of this commodity!) that there is little or no time to go in for shooting systematically. I believe some of our foresters have been out in a desultory sort of way—one, a gallant military officer, got a fair open shot at a herd and brought his quarry to bag, another was knocked down before he had a chance of using his gun, but these are about the only cases of which I have heard. In fact, by Forest officers, they are regarded as a nuisance (O smile not ye tiger slayers!); with never the time to organize a proper hunt and beat the jungle you are at any moment liable to be charged from behind an innocent looking tree by these pugnacious brutes, and then woe betide the man who is not on the *qui vive!* The *inhabitants of the country have a superstitious* horror of them, and will bolt at the slightest sign of their being in the vicinity, leaving their poor sahib to his own devices. To such an extent do they carry this superstition (?) that whole villages have turned out with offerings of rice, plantains, &c., to try and propitiate the wrath of these (to them) terrible beasts rather than try and drive them away.

Owing to the thickness of the jungle, but little success has as yet been obtained in tracking these brutes, for they will travel 40 and 50 miles in the 24 hours when pursued. The natives of the country are useless as shikaries, and having, as I have *just said, a superstitious dread of these "Damya" (for* that is the native name of the wily brute of which I have been telling you), that they are not much good even when the game has been started. I believe the experiment of importing skilled trackers from India has lately been attended with some success, and I would recommend any sportsman who thinks of visiting these regions to engage one or two trackers before leaving India; I am certain the results would be worth the extra expense.

Just one more tip and then I can say that I have done my best to help you—bring your own ammunition if you wish to *go in for a little bye-sport*, with the duck and snipe, which of course is excellent in this sportsman "happy hunting ground." The gunpowder usually sold in our principal towns is...... well, you shall judge for yourselves, for it passes my powers of description! Not long ago I sent down for 6 lbs. of C. and H.

No. 6; the reply came they were very sorry there was no C. and H., but they sent 6 lbs. Hall's FFF., the only sort obtainable. In due course the powder (save the mark!) arrived; the first canister I looked at had been eaten through by rust (or white ants!) in about 20 places, and contained one large solid cake of some hard reddish-looking substance, which had to be pulverized with a hammer before it could be got into a cartridge. Being the only stuff available I had to use it, but as I have never yet managed to hit anything with it, I cannot say what sort of penetration it gave. The other five canisters were all up to this sample.

And now having so generously and gratuitously given you all the tips I can, there only remains to tell you where to go and to speed you on your way. By the bye, if you would like to see a specimen of the Damya in captivity before coming to Elysium, there are one or two specimens in captivity at Pondicherry, and several more, both male and female, at Ratnagiri, but if you would hunt this wily denizen of the jungle in his native haunts, you must take passage to Rangoon, and apply to the Inspector General of Police, or any other officer, Civil or Military, who will I am sure be only too glad to give you the latest khaber of the largest herds of Damya, or Burmese "Dacoits." Good luck to you!

FOREST GUARD.

CLEARING CONTOUR BANDS THROUGH DEODAR FORESTS.

In the Punjab Annual Report for 1885-86 is mentioned a system of clearing contour bands through deodar forests to aid natural reproduction. The Government of India in reviewing the Report has requested that "practical effect should be given.........to the proposal.........for clearing contour lines of shrubs and grasses in suitable localities." I am, however, at a loss to know how, or in what places, it should be tried, nor do I at present see, what greater benefit can be derived from it, than from the various methods in vogue in the Chamba forests (which are prescribed in the working plan of the Upper Ravi forests), and shall be glad if you can enlighten me. In Chamba the forests may be roughly classed as exposed, and sheltered. The former class contains deodar more or less pure, there being a very small admixture of oaks, horse chestnut, &c.; the latter class comprises forests situated on the sides of deep, dark ravines, in which the deodar appears almost only on the crests of the spurs, almost pure, while the smaller ravines have hardly any deodar, generally containing chiefly horse chestnut and other inferior species. In the first class, our plan is to cut such deodars as oppress the young growth, clear out all

inferior species, and work up the soil around isolated seed bearers, besides planting all large blanks far from seed bearers. In the second class the inferior species are cut out, only from among or near the deodar, as far as it is likely the seed will fall, and the soil is also prepared or worked up; near seed bearers large blanks are planted. Such being the case, it is not understood where the contour lining can come in with any advantage; for, in the exposed (or pure) forests there is very little to cut out, and in the sheltered forests our plan is, it would appear, much more thorough and systematic; as all inferior species are removed from the vicinity of the deodar, and full scope is thus given for natural reproduction of deodar alone, wherever possible. In the case of contour lines, it seems to be quite as likely that inferior species will be produced in the lines, as deodar, seeing that, presumably many seed bearers of these kinds will still remain above the lines; whereas, under the plan of cutting all of these, nothing but deodar should be produced in the cleared spaces. Again, if the contour lining be successful in producing a growth of deodar, surely a very patchy forest will result. The lines alone will contain deodar, and eventually the forest will consist of mere bands of deodar with the intervening spaces covered by a forest of inferior species. If these lines or bands are very close together, then it is nothing more than our plan of removing inferior species; and to attempt to keep down all inferior growths, whether of trees, shrubs or grasses would, if done on a large scale, be enormously expensive, and be suspiciously like that "gardening" on which such large sums have been wasted in the past. There is no doubt that deodar reproduces itself very well if fires and grazing are put a stop to, and if to this be added a system such as I have described, it would seem that all is being done that is necessary to secure the end desired, and these measures are free from the objections of being partial and unsystematic, objections which I maintain, apply to the method of making contour bands, which can only, in my opinion, result in a very irregular forest. It will no doubt be of service to us, if the advocates of this plan will be kind enough to explain where we can employ it, under the circumstances above mentioned, in the Chamba forests.

J. C. McD.

GERMINATION OF BABUL SEEDS.

"G. J. v S." in the February number of the "Indian Forester," seems to challenge information as to whether 'babul' seed is improved as a germinating seed by being passed through goats, and whether any kind of seed can be so benefitted by being passed through birds?

As regards 'babul,' "G. J. v S." is perfectly correct in his surmise, that *babul seeds* are not passed from the mouth to the anus of goats. Babul seeds seldom or never do pass completely through the goat, though they do through individuals of the bovine species. What happens in the case of the goat is this—the whole pod, seed and all, is eaten and goes into the first stomach, then follows fermentation, which often, if not always, precedes the hour of rumination. Rumination as a rule takes place where the animals are herded, *i.e.*, where their dung is collected. Here if anyone will take the trouble to watch a goat, he will see it, during the process of ruminating, spitting out the seeds, which naturally fall amongst the dung and get swept up and stacked with it by the shepherds.

"G. J. v S." now infers that the benefit the seed attains, *viz.*, that of being able to germinate quicker than ordinary seed, is due to the place where it falls. Here I take objection, and would ask him to try the experiment of placing a few ordinary babul seeds in a similar situation, and he would find that a very larger percentage would not germinate at all until the usual course of two hot weathers had been passed over. Whereas nearly every one of the quidded seeds would germinate in the first monsoon. It matters not how soon after quidding the babul seed is removed from the dung, it is always the same good germinator.

I have heated, both in manure and water, babul seeds, and find that by gentle heating it often happens, that you can get seeds to germinate at once, but being an operation in which the temperature may by accident be carried too far, or not far enough, failure to germinate often ensues. Whereas this cannot take place in the stomach of the goat; this is a process that can never be altered, and consequently never fails.

With reference to birds, I know the case of the *Melia Azedarachta*, the seeds collected by me specially for plantations were those which bore unmistakeable signs of having been through a bird's stomach, and as in the case of the babul, so in those of this seed, no comparison as a rapid germinator could be found between it and any other fermented or non-fermented seed of this same species.

WEST BRIGHTON, *11th March, 1887.* — R. F.

CLEARING FIRE LINES OF FOREST GROWTH.

IN reply to "Q." In the Central Provinces, where fire-protection has been carried on for many years with considerable success, combined with cheapness, it has been found that a good and effective fire-line should be 40 feet in breadth or more, and

should be entirely cleared of all trees and undergrowth; and, where feasible, grazing on this line should be prohibited. Soon after the rainy season, all fresh undergrowth of shrubs, &c., should be cut away, (if this work is promptly carried out each year immediately after the rains cease, the growth from the stools and stumps on the line will decrease and eventually die off,) and the grass on the reserve side cut for a breadth of some 12 to 15 feet according to length of grass, and the cut-grass thrown on the outer side of the cleared space, and in a week or more this grass is ready for burning,—and in a few weeks later on the standing grass on the line will also be dry enough to burn—and thus a complete fire-line will be obtained. The fact of having no trees on the line will save it from being constantly covered with leaves, and avoid the risk of fires thus crossing over; and having the undergrowth cut away early in the season makes the grass on the line dry up sooner than that in the forest on either side; and having a fringe of grass on the inner side cut and burnt first prevents any risk of fires entering the reserve when burning the line; and by having the grass on the line protected from grazing a perfectly cleared burnt line is obtained, which obviates the necessity of "burning over" several times which otherwise is required.

17th March, 1887. D.

GERMINATION OF BABUL SEEDS.

HAVING seen an article in the "Indian Forester" for April 1887, headed 'Germination of Babul Seeds,' I beg to say that, if it be purely for the sake of germinating of seed, that it should be necessary to pass through goats, it may be avoided, as it can be effected more efficaciously if the seed be steeped over-night in fresh cowdung, mixed with water of equal weight, and sown broadcast the next morning. This will have the desired effect, and is a procedure practised by the Bengalees in Lower Bengal, which I have seen, but never tried myself, not having the occasion.

J. C. SEDNEM.

II. Official Paper.

NOTE ON THE GOVERNMENT FORESTS OF BAHRAICH (OUDH) FROM THE POINT OF VIEW OF THE CHARACTER OF THE WORKING-PLANS DEMANDED FOR THEM.

By E. P. Dansey, Esq., *Assistant Inspector General of Forests, and formerly in charge of the Bahraich Forest Division.*

Classification of the Government Forests in Bahraich into four classes.—The Government forests in Bahraich (Oudh) can, for the purposes of the present Note, be divided into—

(A). Sissú and Khair Forest.
(B). Sál Pole Forest.
(C). High Sál Forest.
(D). Haldu and Dhao Forest.

2. *The Sissú and Khair Forests.*—To (A) belong—

(*a*). The North and South Burthapur Blocks,
(*b*). The Bardia Block,
(*c*). The Amba-Terhi Block,
(*d*). The Sujowlee Block,
(*e*). The Dharmapur Block,
(*f*). The Doba Block,
(*g*). The Babaya Block,

all in the Motipur Sub-Division, and aggregating an area of some 110 square miles = ⅓rd of the total extent of the Bahraich State forests.

The above tracts are, one and all, very unequally covered with forest, including, as they do, extensive grass lands that stretch away in every direction. Most of them have, in this way, a park-like appearance from the very irregular distribution of the trees, either in isolated fashion or in straggling clumps and groves. Thus the Doba Block can only by courtesy be described as a forest at all, seeing that it is merely a wide expanse of grass and tamarisk, with but a few khair trees standing at long intervals.

The only valuable species (in the present state of the market) found in these Blocks are khair and sissú. But whereas almost all the suitable khair trees have, by this time, been boiled down into catechu, the sound sissú have in the same way disappeared to meet the demands of the gun-carriage manufactories. Unsound or inferior trees alone remain to represent these two

useful species, since of their recent reproduction there is no important evidence anywhere.

Not one of these Blocks has been protected hitherto from either cattle or fires, and the open ground being generally covered with a dense and tall grass (subsequently burnt down by fires) or with a matted turf (where heavily grazed over) tree reproduction is only rendered possible along the water-courses, and in the more impenetrable groves.

Since there is no reason whatever why even fourth-rate forests like these should not become very valuable hereafter for the supply of fuel, let alone the requirements of the catechu trade, and the always considerable demand for sissú timber, our policy here should evidently be to close to cattle and fires, and to all present working, as large a tract as we can with due regard to the exigencies of the surrounding populations—exigencies that pertain mostly to their requirements in pasture land.

There would, in this way, appear to be no valid reason why we should not immediately close and strictly preserve—

(*a*). The North-Burthapur Block.

(*b*). The Sujowlee Block north of a line to be drawn due east from the river Gogra, and which would exclude a sufficient grazing-area to the south for all the villages in that direction.

There being absolutely no present demand for the species contained in the above Blocks, except in the case of such as have already been too exhaustively drawn upon, the Working-Plans for these forests would have to be prepared on exceedingly simple lines—providing merely for their continued protection and improvement, when possible, and for the re-stocking of blank areas, where desirable, with useful species, such as khair and sissú.

It would, of course, be necessary to exclude (by exchange, or otherwise) the village lands of Jamúnian and Dhakia in (*b*).

The border village of Kutes in Burthapur has ample waste lands of its own, besides which it is partly situated in Nepál, under conditions permitting of abundant grazing facilities in that territory.

3. *The Sál Pole Forests.*—Under (B) can be classed—

(*a*). The Churdah Forest.

(*b*). The Chakia Forest.

(*c*). The Motipur Sál Forest.

All three are mainly composed of sál, and that principally in the form of coppice-poles of varying age and dimensions.

4. *The Churdah Forest.*—The Churdah forest differs from the other two mentioned above in this that it is an almost unmixed sál forest, other species being very few and far between. It differs again in this that it is almost wholly constituted of young coppice-poles, young seedling trees not existing, and mature, or even large-sized trees of any kind being very scarce.

If we except certain tracts along the western and northern borders of this forest, and which are remarkable for the number, the well-shaped proportions, and vigorous vegetation of the poles there seen, the condition of the stock is unsatisfactory, although the ground itself is generally sufficiently well covered with trees. Almost every other stem is, in this case, crooked or mis-shapen, the result of former high-cutting and continuous pollarding. The soil itself is, here, exceedingly dry and poor, and for this reason Sir D. Brandis was always opposed to any immediate operations of improvement which could not be effected without uncovering the ground, and the more so that the dimensions of the poles are as yet generally small, both in height and in girth, and the difficulty of excluding cattle considerable.

Conditions have, however, much changed since Sir D. Brandis saw Churdah in 1881. A railroad now passes within an average distance of 10 miles from the heart of this forest, and a brisk demand has sprung up for poles of all sizes and qualities, as also for fuel and charcoal. The estate has, in fact, become a valuable property.

There can be no question that our policy is here to replace by healthy and straight coppice shoots the large percentage of inferior and crooked poles, without promise, that now encumber the ground, and take away from the value of the estate. The longer these are permitted to remain, the less prospect will there be of the roots continuing sufficiently healthy and vigorous for the subsequent formation of good standards. It is, therefore, not, altogether a question of expediency as regards the greater or lesser profits to be derived through permitting saleable poles to attain to still *more valuable* dimensions, so long always as the poles in question are of inferior quality. I maintain that, under the circumstances, it is better to sell for what we can, and replace such poles as soon as we can by material of the best quality obtainable.

In my opinion then we should remove every kind of unpromising growth, and that as rapidly as would be consistent with—

(*a*), the demand for such material (poles, fuel) as would be yielded by the operations ;

(*b*), cultural considerations.

In the present case, the number of deformed stems to the unit of area is, as I have before remarked, very large. Consequently, if we concentrated our improvement operations, we should have everything to apprehend from the uncovering of the ground over large tracts, from excessive evaporation, and the still further deterioration of a soil already impoverished. My experience has been that where sál pole forest has thus been thinned out on dry poor soils, the resulting coppice has ever been a sickly one.

For these reasons, I recommend here the form of exploitation

known as "strip-fellings" or "line-fellings," and which is too well known for it to be necessary for me to enter into particulars. Practice alone can indicate what the width of the lines should be. This question depends, for each locality, on—

(a), the quality of the soil,
(b), the density of the stock,
(c), the height of the poles,
(d), the relative proportion of unpromising stems to the unit of area.

Generally speaking a width not exceeding 30 feet should suffice for this forest.

A considerable tract—five square miles or more—is closed to cattle, and we have there nothing to apprehend from their action. With regard to the remainder, there should be no difficulty in similarly closing one or more compartments at a time, and for short periods. Where reproduction is principally sought for from coppice shoots, as in the present instance, the presence of cattle in the localities worked over should not be injurious to any great extent, after a lapse of, say, two years.

The belts of original forest that should intervene between the lines of exploitation would have to be of at least three times the width of the latter.

The Working-Plan for the Churdah forest would thus be of very simple construction, and, of course, by its nature, of a purely temporary character. The first operations should be of a preliminary type destined to test the local market, and to determine the quantity and form of material that could be disposed of remuneratively. Seeing that the exploitations are here most important for the purpose of improving the estate, it is evidently our policy to carry out these improvements as rapidly as we can, and we should, therefore, be most careful not to imperil the success of the operations at the very outset by looking too much upon them from a purely commercial point of view. We must here, if necessary, sacrifice immediately large returns in order to regenerate the forest within the shortest possible time. The essential is that the works should be self-supporting.

It is hardly necessary to observe that the exploitations should here include, besides sál poles of no promise, every description of inferior species, as also such mature sál trees—not of coppice-origin—as are occasionally met with. The latter are so few as to be but an unimportant factor in the present working of this forest.

It will be objected to here that if this forest were to be worked without any limit as to time, as suggested by me, or at least with only such limits as attach themselves to cultural considerations, and the nature of the demand, then it might possibly happen that the whole area, having been rapidly exploited of all bad growth, an interval would occur during which the revenue from this forest would be nil. To this I reply "What then? If this

forest was in a healthy normal condition, the revenue from it would be *nil now.*" Supposing that creepers fetched a good sale in the market, should I be less rapid in cutting them all down, even though they constituted the sole revenue of a forest too young to be exploited just yet ?

5. *The Chakia Forest.*—The Chakia forest presents features that can be best described as coming between those of the Motipur sál forest and those of Churdah. It is not so uniform a forest as Churdah, not so vigorous or so old a forest as that of Motipur. Without being a pure sál forest like Churdah, it does not contain so large a proportion of inferior species as Nishangára. The ground is not so densely covered as in Churdah, but the vegetation is better, and there is more undergrowth. There is also more sál reproduction, and evidence of many of the recent sál stems having proceeded directly from seed. In Chakia, trees of different ages—from the mature old tree down to the seedling of a few years—go much more to constitute the stock than is the case even in Motipur, although the character of the forest is still that of a young one.

Like Motipur, the Chakia forest is very irregular in the distribution of the good sál localities. There are tracts without poles at all, and in which deteriorated old sál trees alone prevail. There are tracts again in which mohwa, ebony, asna and other inferior species occur to the more or less complete exclusion of sál. And again there are localities—witness almost the whole region east of the Mánd Nála—that have been ruined almost beyond recovery by excessive grazing and exhaustive fellings on the part of the neighbouring privileged inhabitants.

The number of sound mature trees—other than coppice-poles—of species having a present commercial value for their timber, is here again too small to constitute an important element in the provisions of the Working-Plan that is just now required. In the case of sál, they have been nearly all cut out.

As in Churdah, so here, our object, for some time to come, must be to improve the estate by the removal, as rapidly as circumstances will permit, of the very heavy relative proportion of crooked, diseased, mature, or otherwise unpromising sál poles, and by the extraction of inferior species generally, and mature sál trees other than coppice-poles, wherever this last form of improvement is rendered possible by the circumstances of the locality (that is to say, by the small relative proportion of inferior species to the more valuable kinds of trees, and by the condition of sál reproduction generally).

From a financial point of view the Chakia forest is even more favourably situated than that of Churdah, since, besides having the railway almost equally near, the Sarju river affords another convenient high-way for the removal of its produce. Already a very considerable local market exists in Chakia for all sorts of poles, as also for charcoal and fire-wood. The soil again is

generally much better than in Churdah, the trees taller, natural reproduction abundant in places: a considerable area is altogether closed to cattle. There is no reason, therefore, why operations of improvement, similar to those recommended for Churdah, and to be confined by the same considerations, should not be rapidly prosecuted in Chakia.

On the other hand, it must be observed that, in certain parts of Chakia, the condition of the forest is such as to justify our having recourse to concentrated fellings, as opposed to strip-fellings. But the Divisional officer on the ground could alone determine whether the one or the other method should be applied to a particular locality. Certain tracts as undoubtedly require confined operations, as other localities admit of more extended work.

But the outlines of a Working-Plan for Chakia would, in any case, be the same as for Churdah.

6. *The Motipur Sál Forest.*—The Motipur sál forest comprises the two separate Blocks of Nishangára and Murtiha, the former of which has been long closed to cattle and fires, and distinguishes itself from its neighbour—less fortunate in this respect—by the often magnificent undergrowth of sál seedlings which, with the aid of numerous poles of the same and other species, serves to make an almost impenetrable thicket wherever the soil is very rich in character, as it often here is.

The Murtiha Block, as I have observed, is not favoured to the same degree. Its soil is generally much less rich, and the forest has suffered from the greater proximity of cultivation, and from all the evils of easy accessibility. Although we, in Murtiha, have localities that are densely covered over with forest, the absence of recent sál reproduction is yet everywhere conspicuous, and most of the area is either very insufficiently stocked, or is absolutely ruined as a sál-producing tract. (See the extensive belt of bael and khair forest to the west of the Block).

The Motipur sál forest distinguishes itself from Chakia by its more vigorous vegetation, and the much larger size of trees of the same age, and from both Chakia and Churdah by the greater relative proportion in the stock of other species than sál. Mature trees—not of coppice origin—occur here in greater numbers, and there is evidence in this as in the presence of occasional healthy middle-sized trees, that a more considerable portion of the stock has proceeded directly from seed. But although the number of sál trees of superior dimensions, or that have attained to the limits of maturity, is large, these are very generally unsound, and the importance of this element in the stock is never such as to make it desirable for us to shape a present Working-Plan in accordance therewith.

The conspicuous features of the whole Motipur sál forest are that, over considerable tracts—wherever, in fact, the soil is rich—

(*a*), the stock is often too dense, too crowded;

(*b*), the relative proportion of inferior species of little or no value is very considerable ;

(*c*), the proportion of crooked, diseased, and over-mature sál coppice-poles is excessive.

Again, where the trees are not themselves too numerously represented, these same rich tracts are remarkable—in Nishangára at least—for a very luxuriant undergrowth of sál seedlings, several feet in height,—a circumstance which then permits of our removing, if necessary, the entire standing stock of unpromising poles and mature trees without injury to the forest.

The above description of the Motipur sál forest indicates also the provisions which would be generally made to apply in a Working-Plan for it—a Working-Plan based on the *present abnormal constitution of the forest,* and which would be quite sufficient for all present purposes.* There is a fair market—at *cheap prices—for all sizes of sál and asna poles, and there is* some prospect of securing a permanent and considerable outlet for both timber and fire-wood in the direction of Byramghát and Lucknow.

Subject to these conditions as regards the possibility of disposing of the material, a Working-Plan for the Motipur sál

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* Supposing that Lucknow consumes as much as 400,000 maunds of dry fire-wood per annum from this forest, there would certainly be quite 20 years of progressive work on that scale, in the Nishangára Block alone ; and, after that time, it is surely not too much for me to hope that the Murtiha Block will have so far improved as to admit of the same work being carried on there for, say, 10 years. And, by that time, if not long before, the Nishangára Block will want further thinnings.

With regard to all three sál forests of Motipur, Churdah, and Chakia, the fact must not be lost sight of that the stock is essentially young, and that these forests are only workable, therefore, by reason of such extraordinary requirements as those alluded to. I have assumed the correct principle in all such cases—where the State is proprietor, and not dependent on the revenues from these three forests—to be that already previously enunciated by me, *viz.*, to only limit the extent of these very necessary works of improvement by the facility or otherwise of disposing of the produce profitably and by the exigencies of the stock. Under existing conditions it is very improbable that, in either of these forests, we should come to the end of our resources (as measured by sickly and unpromising growth) before *at least 10 years—in Motipur not before 20 or 30 years.* And supposing that we did exhaust the yield of this sort of material within a briefer period, what then? In a healthy condition, these forests should, *normally*, be able to supply no more than they undoubtedly will still continue to supply when the present Plans, based on their improvement alone, shall have died a natural death on the completion of the great work which should now give birth to them.

Assuming that the Plans in question should prescribe time and should prescribe definite areas to be gone over each year, the uncertainty of the demand, more especially in Motipur, would make such a prescription futile except as a maximum limit beyond which operations should never be conducted. And such maximum limit itself would be extremely difficult to impose, seeing that the material yielded in the contemplated works of improvement must vary exceedingly over different parts of the forest, and this is particularly the case in Motipur, rendering it most difficult to apportion the area to the several years of the rotation.

Captain Wood was not wholly wrong when he wrote saying that the time had not yet come for Working-Plans in Bahraich, by which he evidently intended to convey that in the present youthful and abnormal condition of these forests, a very simple outline of policy was alone called for during the present generation.

forests would have to be constructed on the same simple outlines as have already been suggested for Churdah and Chakia. But the system of strip-fellings would be here quite unnecessary; and, owing to the fine undergrowth of sál seedlings that prevails over extensive areas in Nishangára, very heavy fellings in one locality would there be not only practicable, but, occasionally, even advisable.

It must not be lost sight of that this undergrowth of sál has suffered from suppression, and that it will, hence, be generally expedient to cut it flush with the ground after exploitation—the more so that the exploitations themselves will result in severely mutilating most of the young stems comprised in it. The operation suggested would have this beneficial result that a coppice of uniform height and vigour, and possessing moreover all the attributes of young seedlings, would, within a couple of years, take the place of the sickly and diseased crop thus removed.

The advisability of constructing a tramway between this forest and the mart of Sujowlee on the Gogra river, has been often urged. Supposing that the systematic working of this forest is to mainly depend for some time to come on the demand for fuel in Lucknow, and on a departmental system of operations, we can well appreciate the necessity for this means of transport. Present circumstances seem to point that way. But we should not be in too great a hurry, nevertheless. It will be as well first to gauge the requirements of this new market, before committing ourselves to so large an immediate outlay.

7. *The High Sál Forests of Bahraich.*—To (C) belong the Bhinga forest, and the E Gubbapur Block of the Sohelwa forest.

8. *The Bhinga Forest.*—The Bhinga forest is, by no means, a pure sál forest. It is largely mixed with ebony, tikwee, bahera, mohwa, asna, kusum, and other species. And the sál occurs mostly in the form of hollow old trees. This forest is everywhere sufficiently open to admit of sál reproduction; and, in the greater number of cases, it is too open, degenerating off the villages into park-like tracts, in which clumps of trees alternate with grassy glades or with wide expanses covered with impenetrable thorn. Nowhere do we meet with successful sál reproduction. Poles of the species are extremely rare, and then never young, while the soil has become hard and dense, and manifestly unsuitable to sál. The whole forest is apparently in a state of transition from a sál to a miscellaneous stock.

Nevertheless, we should not, under present circumstances, despair of the future of the Bhinga reserve in its capacity of a sál-producing tract. It must be borne in mind that this forest has been subjected to exaggerated ill-usage, for many generations past. We should not be justified, therefore, in treating this forest as one in which sál had no future, before this circumstance had been practically ascertained beyond any reasonable doubt. In the very small areas that have, for some ten years,

been more or less successfully closed to cattle and fires, a manifest improvement has already taken place, both in the soil and in the condition of the forest generally; and we should not, in the present stage of our knowledge, despair of ultimately restoring this very ancient sál forest, although it will, of course, take many scores of years to effect this desirable end.

Since the forest has, everyhere, been already quite sufficiently thinned, pending the appearance of an undergrowth of sál, a Working-Plan for the Bhinga reserve would aim mainly at procuring for it—say for the next fifteen years—as large a share of repose, of the most absolute kind, as was compatible with the acknowledged rights and requirements of the surrounding populations. Exploitations would, during that time, have to be confined to dead and dying trees.

From the operation of the Plan should, however, be excluded all such tracts (lying off the villages) as it will evidently be necessary for us to permanently surrender for purposes of grazing and village-supply—tracts, for the most part, already deteriorated beyond repair. It would be a useless and wasteful extravagance on our part to leave unfelled, under these special circumstances, any valuable timber, already mature, so long as we suffered to remain as many trees as were necessary to maintain such forest in its condition of pasture land. For this purpose there will generally always be found on the ground a sufficient number of inferior species and shrubs of sorts, without it being necessary for us, in view of a reproduction of sál that will surely never come, to abandon saleable mature trees of that species. Hollow old sál trees are eagerly bought up in Bhinga, and either made into canoes, or split up into rafters, props, posts, and ridge-poles (all for house-construction), or into cattle-troughs, and a number of other useful commodities. Since nearly every mature sál tree found growing, under these conditions, is already hollow, their removal should, evidently, only be regulated by the facility or otherwise of disposing of the *material to a profit.*

The great difficulty, in Bhinga, will be to deal with the "privileged" villagers and their requirements, and this in such a way as to secure the absolute repose I have referred to for the largest possible area of forest.

It need hardly be observed that the problem of re-stocking the Bhinga forest artificially, and at a recuperative outlay, should never be lost sight of, and that experiments should be from time to time had recourse to with this object in view.

9. *The Gubbapur Block.*—The Gubbapur Block of the Sohelwa forest is the only sál forest in Bahraich which at all approaches to the irregular character of a normal forest of that species—that is to say, a forest in which trees of all ages occur associated together in natural fashion. But it is, by no means, a pure sál forest. While sál is here always found in company

with a large proportion of inferior species (principally dhao, tikwee and asna) there are tracts occupied by tikwee and dhao, or by these and other species combined, *to the total, or almost total,* exclusion of sál. Off cultivation again, expanses of deteriorated forest occur in which thorns prevail along with unsound old sál trees at intervals. In other respects, the character of the forest is a healthy one, and the vigour and abundance of the young growth of sál is then often a striking feature of the locality.

While the lower portions of the Block have been, as a general rule, already exhausted of their stock of mature sound sál trees, there is much of the hilly zone above that has altogether escaped, and, in this way, there may be said to be still much sál timber of good dimensions and quality in this forest, that is immediately available, let alone asna trees of superb dimensions.

What we have to do in Gubbapur is to arrange for the gradual *exploitation of the present stock* of mature sál trees, and that during a period which will be sufficiently long to enable an equal number—after allowances have been made for the abnormally great age to which some of the present stock of mature trees have been allowed to grow—of the younger trees to reach the dimensions recognized to be the most useful for the requirements of the State in this direction, and which are probably *here represented by a diameter of 2 feet.* Owing to the very unequal distribution of the sál trees in this Block, a complete enumeration survey of the 1st and 2nd class trees would have in any case to be made. Since, however, in practice it is impossible to conduct a complete enumeration survey *accurately* over a forest without taking stock of all, or nearly all, the trees of the same species, it would be preferable to include in the survey every sál tree exceeding 6 inches in diameter, and these would, of course, be divided into a larger or lesser number of classes, according to the accuracy required. In the present instance, the following classification should suffice—

I.	1st class trees, ...	2′ diameter and above.
II.	" "	1½′ – 2′ diameter.
III.	" "	1′ – 1½′ "
IV.	" "	6″ – 1′ "

The survey had here better be executed Compartment by Compartment and be supplemented by an accurate description of each. The Compartments should be defined, as regards situation and extent, by roads and water-courses, and no attempt *should be made to constitute them on any other basis.* Only such tracts should be included in the survey as came within the specially protected zone—that preserved from fires and cattle—or which, it was premised, would, later on, come within the influence of protection. Such areas as must *necessarily* be left open to cattle, had better be treated in the way suggested for a similar condition of things in Bhinga.

It would be necessary to distinguish, in the survey between the sound and the unsound sál, and the Working-Plan would provide for the progress of the exploitations, over such parts only as were ripe (by reason of an abundant undergrowth of young sál, or the number of existing trees of that species) for the purpose.

Owing to difficulties of ground, the extraction of *logs* would, in a few localities, be found impossible.

In the present state of the market, as regards asna, dhao, and tikwee, it is manifestly unnecessary to include them, or the other prevailing inferior species—except in a general way—in the provisions of the Working-Plan, unnecessary, therefore, to take stock of them. The principle followed in reference to all species other than sál should always be, in sál forest, to cut out the former to any extent compatible with their profitable disposal and immediate replacement by sál of good promise, and that, of course, most generally, without recourse being necessary to artificial means of propagation.

The soil, in Gubbapur, is almost everywhere suitable for sál, and it is suggested that the latter might be rendered much more abundant than it is by a judicious distribution (by the process of dibbling, for instance) of seed over the surface of the protected areas. There are here large tracts, now containing nothing but tikwee and asna, which could be transformed in this way, it is urged, into valuable sál forest. It must be borne in mind that the sál seed is not shed to more than 100 feet or so from the parent tree, and that this circumstance is much against a rapid spread of the species over lands from which it has been once ousted, or which it has not yet invaded.

10. *The Sonpathri Block.*—Under (D) I have only that portion of the Sohelwa forest to mention, which is known as the "Sonpathri" Block.

Although merely a continuation of Gubbapur in an easterly direction, the character of the forest is no longer the same, or is similar only to isolated localities in that Block. Its distinguishing feature is that, if we except a few unsound old sál trees that we find distributed at very rare intervals through the forest, and groups of sál poles of mean appearance occurring in insignificant numbers along a few of the water-courses (mostly towards the base of the hills) the whole tract is destitute of this valuable species, those prevailing being principally tikwee and dhao, associated with burgat, dhâman (Grewia), pipal, jaman, siris, kusum, khair, bael, rohni, &c., &c. Much of this Block (east of the Sonpathri Kula) is in a semi-ruined condition from over-grazing, over-felling, and annual fires, and the whole of the Block has, in a greater or a lesser degree, degenerated into a thorn scrub for a considerable distance off cultivation. Not until 1885 did we succeed in placing any portion of the Sonpathri under special protection, as regards

grazing and fires, and then only about one-fourth of the total area.

What we have to determine in this Block is whether, with a judicious selection of the more suitable localities for the purpose, we could not, by means of dibbling or other artificial processes, again succeed in extending the areas covered by sál, as suggested by me in the case of the previous Block.

My own opinion is that this is perfectly feasible, and that the *improvement could be effected with very little comparative outlay*, seeing that the soil is generally such as sál can reproduce itself in, its main defect being an excessive dryness. It will, however, be borne in mind that I nowhere advocate these works for localities in which this dryness of the soil is so conspicuous as to be characterized by peculiar conditions of vegetation, such as pure dhao, khair or bael forest, that I only propose having recourse to these works in the better parts of the Block, and particularly so in those parts which have been recently closed.

The working of the Sonpathri Block has—if we except the considerable quantity of material supplied annually to the neighbouring villages—hitherto been confined by us to the removal, by purchasers, of dead wood (for firewood and charcoal), and *to their extraction* of a certain quantity of catechu. There is absolutely no present demand for the kinds of timber found in this forest other than that centred in the requirements of the immediate locality, and these we are compelled to meet without a payment in return.

A Working-Plan for the Sonpathri Block would, therefore, merely arrange, for a term of years, for such improvements as *I have already suggested, and indicate the localities, and the* circumstances under which, the present demand, if any, should be supplied from.

Supposing that the conversion of this forest into a sál forest, over large tracts, were shown to be possible, and at a small comparative outlay, the Working-Plan would lay down the area to be thus annually converted, and the exploitation of all other species would then—after a time at least—have to be regulated by the requirements of the case, and by the area to be in this way regenerated each year.

11. *Conclusion.*—Generally speaking, the whole of the Bahraich forests have been much overworked in the vicinity of cultivation. There is thus much danger that the villagers, in the absence of reproduction on the tracts thus ravaged by their fellings, by their fires, and by their cattle, will, before long, insist that the portions of forest under improvement by us may be similarly opened out to them, and for similar purposes of ruin and waste.

The Working-Plan for the Bahraich State forests will, therefore, necessarily, make the best arrangements possible whereby *the last mentioned alternative shall either be entirely obviated, or,*

at least, be only permitted in cases where the condition of the forest (as in Nishangára) is such as admits of much thinning and weeding out of young trees. Seeing what a deteriorated condition all the State forests of Bahraich are in already, this becomes a very difficult question. In Bhinga there would appear to be absolutely no compromise possible. The whole forest is in such a condition that Government has only three courses before it :—

(*a*), to open presently the closed tracts to the villagers, and submit to the gradual ruin of the entire reserve ;

(*b*), to say that the present closed tracts shall not be so opened under any circumstance, and submit to the devastation of the rest ;

(*c*), to abolish the privileges altogether—at least in their present shape—as being incompatible with the life of the forest, and the undoubted interests possessed in the latter by the population of the district generally.

Evidently, the pasture of cattle would have, in the same way, to be regulated in harmony with the requirements of each Block or forest for which a separate Working-Plan had to be made.

The preparation of Working-Plans for the Bahraich Government forests would thus not be a work of much labour, they being necessarily very temporary in character, and simple in outline. All of them could conveniently be entered in a single report of the size of an Oudh Annual Progress Report, and one officer (not the divisional officer) should be able to prepare the whole of them within a single Working-Season.

In the sál forests alone would I recommend any division into Compartments, and then I would have the area of each Compartment as large as was advisable for motives of easy description, working, and control. In the present case, 3 square miles will not be found too large for the purpose, the stock being often very homogeneous in character over large tracts, as in Nishangára and Bhinga, where 5 square miles of forest and more could, with sufficient accuracy, be described as uniform in type throughout.

The Revenue Survey Maps of Bahraich are quite correct enough, and quite large enough, for the purposes of present Working-Plans in that district.

III. Notes, Queries and Extracts.

The Madras Forests.—A correspondent writes to us :—Your paragraph on the forest question in Madras, has a mournful interest. One could hardly have believed that Government could have thrown open its best reserves in Tinnevelly to practically indiscriminate cattle grazing. Yet on the best authority I learn that this was done last year. The not unnatural result was a bad fire in a reserve that had been protected for years, and thousands of rupees damage to timber and forest products. The damage to the country generally and to the ryots is incalculable. The Madras Government seems incapable of properly appreciating the forest question. The late Governor, it is true, took an interest in it, and with the help of Dr. Brandis, the Forest Act was passed, two decades too late. But, in the administration of the Act, the present Governor is, I fear, as retrograde as ever, and listens to the short-sighted complaints of those who objected to conservancy on the ground that it is inimical to the production of cattle. The most ridiculous complaints are constantly published in the Madras papers. One man dilates on the importance of cattle to the country, and then deplores the exclusion of cattle from certain forests, forgetting that for many years all the forests have been given up to the grazier. The agriculturists do not send to the forests their well-bred useful cattle that plough and irrigate and draw carts. It is only the poor useless beasts worth no more than their hide, and the cows and immature animals, that are sent there. During their stay in the jungles the immature heifers are covered by worthless sires, and the worst features of Indian cattle breeding perpetuated. Fires are lighted intentionally to secure the crop of green grass after the first shower; or sometimes accidentally through carelessness, and each year the forest loses several year's growth, and the doom of sterility is made surer and surer for the south of the peninsula. The grazier first destroyed all the more accessible jungles. Now he would lay his hands on the poor remains, saved so long by their inaccessibility, and which are now, the so-called reserves. One of those who have lately aired their grievances in the Madras papers naïvely exposes the real nature of their claims. He speaks of "those who live on the outskirts of Government forests, and are unfortunate enough to own cattle. It is plain enough that the peasants whose villages adjoin the forests have become cattle dealers, their stock being reared solely on their neighbours' woodland. It is natural enough that

they should be displeased at their usurpation being put a stop to, but their complaint should be regarded not as the legitimate complaint of a poor man deprived of an undoubted and reasonable right, but as the howl of disappointed avarice; disappointed in the hope of making a profit at the expense of the general public. In 1882, the business of conservancy seemed really to have started in Madras, but last year, all progress seems to have been stopped, and the measures of Government are now actually retrograde. As I write, I can see on a neighbouring hill-side a beautiful line of fire which marks where the jungle is burning merrily. Very likely this is one of the Forest Department's reserved forests. If unburnt, it might have yielded valuable products and provided bountiful pasture for cattle in the next famine. Now that it is burnt, it will keep alive a few worthless beasts, rear a few ill-bred calves and plenty of goats, and put a *few rupees into some cattle dealer's hands, but* not benefit *the* cultivator or the labourer. The country has lost so many hundred acres of timber, so much more soil will be swept down in the next rains. Some stream will have a little less water in the hot season, and in the rains will be a worse torrent than before;—perhaps the extra rush of water exceeding the utmost that some engineer has calculated on, will burst some tank, or wash away a bridge;—and all because Government will not accept the teaching of science, and lends a ready ear to the outcry of the ignorant. Not only is the protection of the reserves neglected, but I understand that it is contemplated to reserve no more, though the forests are far short of the requirements of the country. In some cases, lands are being thrown open, not because they are unfit for forests, but because they may be wanted for increase of cultivation—a reason which is not justified by facts. A small extension in the area of badly cultivated lands is no great benefit to the community, but a bit of natural forest which is worth reserving, is a possession of great value, which when once destroyed it is almost impossible to replace.—*Indian Agriculturist.*

GAME PRESERVATION AND FOREST LAWS.—I have read with much interest the various letters which have appeared in your columns on the above subject, and with your permission would like to make a few remarks thereon.

"Gamekeeper's" statement that deer are slaughtered on a large scale during the rains is no doubt perfectly true, and he would be doing us all a great service by informing me which are the exact localities where these practices are carried on. I now invite him publicly to write to me, or, if he is a Dehra man, to let me know verbally where he saw the chapars or shanties and all the signs of a hunter's abode; and I will undertake to have that locality carefully watched next rains, and will do my

utmost to bag the whole gang of poachers. I do not expect very much in this way from forest guards, but I do hope and trust that all sportsmen in the Dún will assist the Forest officer, as far as lies in their power, by informing him whenever they see the shooting rules broken. In my opinion this will be far more to the purpose than writing to the papers months afterwards, though I, for one, am very glad to see the matter discussed in your columns.

There are about 400 gun licenses issued annually by the Superintendent of the Dun to zemindars and others; add to this the "Company" guns of the two Gúrkha battalions, and the unlicensed guns alluded to by "Gamekeeper," and you have a formidable array of arms pretty steadily at work, quite sufficient to account for the disappearance of game. It is not always the holder of the license who shoots. Two cases have recently come under my personal notice. In one case the sportsman with a sambhar stag on his shoulders was a Gúrkha pensioner—the holder of the gun license, a havildar in the regiment; in the other case the would-be sportsman was a Gúrkha line boy, but he was "headed," and politely requested to return to Dehra. All these cases are punishable under the Arms Act.

But the remedy lies partly with the Superintendent of the Dun—let him issue only one-half the number of licenses, and cut the gun barrels down to a length of two feet—and partly with the higher Forest authorities, or the proposed Committee on the shooting rules; let them decree that there shall be no shooting whatever in the Government forests except on payment of a certain fee, and obtaining a non-transferable license. Carry out these two proposals and much will have been done to increase and preserve the game in the Dún. Then, if tigers and other "dangerous and destructive animals" increase and multiply to such an extent that "H. L." will have to pay an enhanced rate for his beef (*vide* his last letter to the "Asian"), a raid can easily be made on them by the license-holders at any time of the year. Even as matters stand at present, if village cattle are being carried off in any particular locality, special leave can be given for the destruction of the marauder.

With regard to fishing with small mesh nets, is "Gamekeeper" aware that the rules at present apply only to such portions of the streams as run through Government forests? Fishing with nets is at present unfortunately quite legal in zemindari waters (nearly the whole of the Asan and Tons, the upper waters of the Song and Suswa); and what can be expected from the native when a large European zemindar sells the right to net the river running through his estate; when another European resident of Dehra, learned in the law, furnishes a man with a cast net and a pass saying "This is my fisherman;" and our neighbour the Raja of Nahan allows netting in the lower part of the Giri river? What we want here is a Dehra

Dún Fishing Association and a strongly-supported application to the powers that be to pass a stringent law on the subject. The local Legislative Council might turn their attention to this question. On this matter the letter of the Honorary Secretary, North Punjab Fishing Club, reported in the April number of the "Indian Forester" from the "Civil and Military Gazette," is worth perusal. Now if "Gamekeeper," "Deerstalker" and "H. L." will only put their heads together, and call a public meeting, inviting the attendance of all true sportsmen, I feel convinced that good will result, and wholesale destruction of game and fish in the Dún become a thing of the past.—A. SMYTHIES.

DEHRA DUN, *Easter Monday.* —*Asian.*

CLOSING GOVERNMENT FORESTS.—In the rules regarding shooting in the Dehra Dún Government forests, lately published in your paper, there are two provisions which require modifying—

1st.—The closing of the forests from the 1st February.

2nd.—The re-opening of them on the 16th July.

The 1st February is too early for closing the forests; not only is February the pleasantest month in camp, but large cheetul horns are seldom obtained perfect before this month (in this part of the world at least); so that cheetul shooting is practically forbidden altogether, as they must be shot with their horns in velvet, or not at all. Then why should such an early date be fixed? I believe that Europeans might be allowed to shoot at all seasons without any fear of their setting fire to the grass; but certainly during the whole of February the grass is too green to burn; and as, from a sportsman's point of view, there is no objection to shooting stags in that month, it appears a useless piece of tyranny closing the forests before the 1st March.

As to the second point, no Europeans care to shoot in the Dún between the 16th July and the 1st October; why then declare the forests open during that period solely for the benefit of native poachers? I trust you will assist us by advocating the keeping the forests open from 1st October to 1st March only.—DEERSTALKER.—*Asian.*

THE paper on Swiss Forest Management, which appeared in the April Number, is by Mr. G. Cadell, formerly of the Madras Forest Department, and now residing at Lausaune.

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A FOREST TOUR IN PROVENCE AND THE CEVENNES.* *By* MAJOR F. BAILEY, R.E.

ON the 22nd April, 1885, a party, consisting of MM. Puton and Boppe, the Director and Deputy-Director of the Forest School, Mr. Elliott, of the Punjab Forest Department, nine English students, Mr. Takasima, a Japanese gentleman studying at the school, and the writer of these pages, left Nancy for Marseilles. After we had passed Dijon, and before darkness set in, the line led us along the foot of the Côte d'Or hills, which are famous for the wine they produce; and when morning dawned we found ourselves near the mouths of the Rhone, crossing the desolate Plaine de la Cran, which consists entirely of pebbles and gravel, and is probably of glacial origin. It is quite uncultivated, and is likely to remain so until the works now in progress for leading the turbid water of the Durance to deposit their silt upon it are somewhat more advanced, and until a fringe of forest can be raised on the northern side, as a protection against the terrible *mistral* wind which blows from that direction. The sudden change of 5½° of latitude we had passed through, made itself evident by the advanced condition of the vegetation. At Nancy the leaf-buds were only bursting, whereas at Marseilles the trees on the numerous boulevards and in the beautiful public gardens were in full foliage. Here we observed a number of palms in flower, and a small species of bamboo, not unlike the Himalayan *ringal* (*Arundinaria falcata*); while near our hotel was a fine row of Australian gum trees (*Eucalyptus globulus*), 6 feet in girth, and said to be seventeen years old. It is not possible to leave Marseilles without remarking on the magnificent mules which one sees everywhere in the streets, some of them being probably 17 hands high. These animals, laden with a most unnecessary amount of cumbrous harness, are put into the waggon-shafts,

* From the Transactions of the Botanical Society of Edinburgh, Vol. XVI., Part III. (Read May 13th, 1886).

preceded by a string of three or four horses and ponies of gradually diminishing size, and the team is finished off with a very small pony, or sometimes a donkey! We also saw a number of active, wiry little Algerian ponies running in light carts, and reminding us of a good class of northern Indian country-breds.

The Forest of La Sainte Baume.—The railway from Marseilles to Aubagne passes through a very pretty bit of country. On the high ground the Aleppo pine (*P. halepensis*) grows in fair abundance, the white limestone rock appearing through its dark foliage. At the foot of the hills, in the fertile valley through which the line follows the stream, numerous chateaux and villas were seen, some of them standing in beautifully kept grounds, containing trees and shrubs of many kinds, most of which were in spring leaf, the horse-chestnut and black-thorn being in flower, whilst fresh green meadows, studded with white narcissus and other flowers, flanked the railway. On leaving Aubagne we travelled on a branch line to Auriol, near which place the country became more wild, and the number of vine terraces increased; but it was sad to note the desolation wrought in recent years by the *Phylloxera*, the terraces, which in prosperous days were built at an enormous cost, now showing only the stump of a vine here and there, other crops being raised upon them. It is said that it will be necessary to wait three years before replanting the ground, and grafting an American species of vine; this will not involve a very heavy outlay, but in the meantime the loss of the grape crop is most severely felt. On arriving at Auriol we were received by a forest guard, who had brought two carriages to convey us to the village of St. Zacharias, where we were met by MM. Delaporte and Rogé, the local Inspector and Sub-Inspector; and accompanied by them we started on a walk of eight miles to the Hospice of St. Baume, where we were to pass the night. The Provencal region, in which we now were, differs widely from that which we had left at Nancy. During half the year rain very rarely falls, and the country then becomes excessively hot—"as hot as India," as a friend of the writer, who passes the winters at Hyères, and has been in Hindustan, once said to him. The nature of the forest vegetation is completely changed by this distribution of the rainfall, the number of species being much smaller than it is in more favoured localities. Here is found the Aleppo pine, which characterises the hot districts bordering the Mediterranean, the broad-leaved kinds being chiefly those with persistent leaves, such as the wild olive and the evergreen oak (*Q. Ilex*). The trees do not attain such large dimensions as those in the north, but they are of sufficient girth to yield useful timber, and they grow wherever they can find a little soil in which to establish themselves. The shrubs are for the most part evergreen, and bushy in form, one of the principal kinds being the dwarf oak (*Q. coccifera*), which, growing to a height of about 3 feet, fairly

covers the ground in places; it is associated with several species of juniper and other shrubs. The herbaceous plants are chiefly those which characterise limestone soil in hot regions, most of them having rigid leaves and highly scented flowers; such, for example, as the lavender, the rosemary, and thyme. An undergrowth thus constituted protects the soil, which, however, is not of a nature very liable to erosion, whilst it acts to some extent in arresting the progress of forest fires, which cannot spread rapidly through it. In the part of the hills we were passing through, the limestone rock was visible everywhere, there being hardly any soil upon it—none at all, indeed, in many places; but in spite of this, and of the ill-usage the forest, which is private property, is subjected to, there is a light crop of pine and oak growing spontaneously; the latter being treated as a simple coppice, cut for fuel every five years. Sheep are admitted, but not in large numbers, and it is probable that the harm they do is small, in comparison with that caused by over-cutting, there being little doubt that, if this were restricted, a fine forest could be raised in spite of the limited grazing that is practised. There were a great many caterpillars on the pines, which seemed to suffer a good deal in consequence. As we rose higher up the valley, the hills became more bare of trees, and their appearance, furrowed by dry water-courses, marked by numerous small landslips, and scored over by a network of sheep-tracks, forcibly reminded those of us who had been in the Punjab, of some parts of that province. As we mounted still higher the slopes became even more barren, and it was easy to imagine how soon a multitude of goats, such as would be found in a similar locality in India, would cause the complete disappearance of the last vestiges of forest growth. After walking for some time through this uninviting tract, we gained a plateau, bounded towards the sea by high rocks, on the soil washed down from which some fields have been established; and at the further end of this plateau is situated the hospice where we were to pass the night.

The hospice of La Sainte Baume (Holy Grotto) is maintained by the Dominican Monks for the accommodation and feeding of the pilgrims who visit the shrine annually during the summer months, to the number of thirty or forty thousand. The sacred grotto is high up in the rocks above, and is said to have been the refuge of Mary Magdalene after the Crucifixion. Notwithstanding that the day was Friday, we were provided with an excellent breakfast, after which we proceeded to inspect the forest, which formed for us, of course, the great attraction of the place. It covers an area of 340 acres, at the foot of the rocks, immediately below the grotto, and has been preserved by the monks as sacred from very early times. Except to satisfy their very limited requirements, it remained untouched until the Revolution of 1790, when it was appropriated by the State.

Some trees were then cut, but very few, on account of the absence of export roads, and to this day it is almost a virgin forest, only dead or dying trees being taken out. On entering it, one is immediately struck by its extraordinary character. Here, in the hot, dry region of Provence, we could imagine ourselves suddenly transported back to Nancy. There are huge beech trees, with oak (*Q. sessiliflora*), maple, lime, hornbeam, and other kinds that are not found anywhere else in this part of the country, certainly not within a distance of nearly seventy miles as the crow flies. There are many yew trees, some of huge size and apparently of great age, and also a large number of hollies. The ground, which is, generally speaking, covered with a deep layer of vegetable mould, was, where the forest was at all open, carpeted with flowers, many of the kinds found at Nancy, the sweet-scented violet and narcissus being very plentiful. *Daphne oleoides*, so common in parts of the Himalaya, was also very abundant, and the whole tract was alive with nightingales and thrushes. The mean altitude is about 2,500 feet above sea-level, and the annual rainfall is 36 inches, spread over six months of the year. The presence of the forest here is accounted for by the theory that the currents of air from the sea on the one side, and from the Alps on the other, meet on the rocky ridge which runs parallel to the coast-line, and discharge their moisture on it; but it seems at least probable that their influence is aided by springs, which rise at the foot of the cliffs in sufficient quantity to keep the soil always moist. However this may be, there the forest lies, surrounded on all sides by barren desolation, and in it are some of as fine trees as one could wish to see. A remarkable fact in connection with them is that their wood is extraordinarily heavy, generally speaking, one-third more so than that of the same species grown at Nancy; this being probably due to the increased light and heat which they receive as compared with those which are found in more northerly latitudes, as well as to the moisture pervading the air and soil. Some of the hornbeam is so heavy that it will not float in water. There are signs of ancient cultivation within the forest—yew trees, apparently centuries old, now standing on the old terraces.

As we neared the foot of the cliff, the trees became stunted, and finally they ceased altogether; but we followed a path leading to the summit, where we obtained a view over the dried-up desolate country surrounding us on every side, and we were then able fully to realise the remarkable position that this little oasis occupies. On our way down we paid a visit to the holy grotto, which contains a beautiful spring of water, as well as many altars and statues, and while we were there the friar, who lives at its entrance, returned; he is a botanist, and had his wallet full of specimens he had collected on his way up the hill. After some conversation with him, we descended through the

forest by another road to the hospice, where the amiable and cheerful monk who has charge of it met us, and after dinner we sought our rooms, and slept soundly on our straw mattresses.

Next morning we shouldered our knapsacks and started to walk across the hills to Aubagne, in order to take the train to Toulon. The first thing that struck us, was that the moment the limits of the State forest were passed, we had left behind us all trace of the remarkable vegetation we had observed the day before. This may no doubt be partly accounted for by protection being less rigid in the private forest we were entering; but it seemed also probable that the natural conditions had changed, the soil being no longer moistened by springs issuing from under the cliffs. We were now in a forest of Scots pine, subjected to uncontrolled though moderate selection fellings, which, notwithstanding the entrance of sheep, permit the maintenance of a fair crop of trees of small size, the larger ones being capable of yielding useful planks. The population is scanty, fires being unknown, and there are very few goats, which it is said do not thrive here. There was a fair undergrowth of young pine mixed with juniper, and wherever the cover was light the ground was carpeted with green herbs. Further on some oaks appeared, one fine old tree 20 feet in girth remaining to testify that they were indeed "giants in the earth" in former days. This forest stretches up to the foot of the high perpendicular limestone cliffs, above which there is a communal forest, managed on the selection method, and said to contain somewhat better trees than those we saw, but unfortunately we were unable to visit it. Before crossing a ridge we came upon an abandoned mine, with a coal seam 8 inches thick, which it does not pay to work. The descent was a very abrupt one, through a simple coppice of evergreen oak, cut at the age of twenty years; but the ground was very rocky, and the crop thin. Lower down we saw isolated Aleppo pines standing among the oak coppice, and there was a good deal of the dwarf oak, the evergreen leaves of which exercise an important influence in opposing the spread of forest fires. The wild, rocky aspect of the hills, and the general appearance of the vegetation, reminded some of us very much of parts of India; but as we approached the stream at the bottom of the valley all this changed, and we were able to note the great difference produced in the growth of the trees by the moister soil. Here were pines of large size, mixed with elm, poplar, chestnut and plane (*Acer platanoides*); while the laburnum and Judas tree (*Cercis*) were in full bloom, and the grass green and bright, the contrast to the scene we had left being very agreeable. Presently the valley opened out, and further on we passed a saw-mill worked by water power, in which planks for packing cases were being cut up, and the road then led through a number of orchards and meadows. On reaching Aubagne we took the train to Toulon,

the railway passing along the coast, and affording some fine views of the sea. Here again the vines are nearly all destroyed, and cereals are grown on the terraces which were constructed for them; but we saw great numbers of olive trees and many fields of "everlastings," which are exported for making funeral wreaths. We were met at the station and conducted to our hotel by M. Madon, the Forest officer in charge of the Maures, to whose kindness and courtesy we subsequently owed so much.

On the following morning we were to have inspected the celebrated Mont Faron, but heavy rain fell all day, a most unusual circumstance at this time of year, and it was impossible to get out; while, as our arrangements for carriages had all been of necessity, made in advance, we could not find another day for the expedition, and had reluctantly to give it up.

Forest of Montrieux.—After a night somewhat disturbed by the roaring of lions in a menagerie hard by, we made an early start in a large omnibus to visit the forest of Montrieux, which is situated in the hills, at a distance of about twenty miles north of Toulon. After passing Mont Faron, which rises close behind the town, an excellent road led us over a plateau between olive gardens and ruined vineyards, and thence down into the valley of the Capot stream, which the previous day's storm had raised to flood level. When nearing our destination we turned down a narrow lane, dashed across a torrent, and then walked through a forest of oaks and pines to the convent of Montrieux-le-Jeune, where we had breakfast. M. Madon then gave us some information about the culture of the olive in this region. The trees are grown up to an altitude of about 1,300 feet, the produce being very variable according to soil and situation. There are two varieties,—the larger of which yields, in favourable localities, a good crop every three years, worth from £8 to £10 an acre; the smaller kind yields a good crop every two years, but the net returns are much the same. The trees, which are always grafted, are usually planted in clusters of two or three together, the group being pruned in various ways, frequently with a hollow centre, so as to favour the production of fruit on the inside as well as the outside surface of the "vase" thus formed. Shoots appearing on the bole of the tree or springing from its base are kept carefully pruned back, the leaves and twigs thus removed being buried below it, so as to avoid taking more than necessary from the soil. The crop is gathered from November to January, the fruit being picked up from the ground, and also plucked; it is then taken to a mill, turned by water-power or by horses, and crushed, with its kernel, in order to extract the oil, the most expensive kind being that which comes from the unripe olives. The trees have lately suffered much from attacks by an insect, the larva of which is developed in the fruit.

M. Madon's little lecture finished, we started to walk through

the forest, sending our omnibus to await us at Belgentier. The forest, which is State property, has an area of 2,700 acres. Like that of St. Baume, it was protected as ecclesiastical property up to the time of the Revolution, and it used to yield a considerable proportion of the oak timber required for the navy; but over-cutting and insufficient protection have now reduced it to a very poor condition, and trees capable of yielding wood of this class are nowhere to be seen. It is difficult, indeed, to realise that they ever existed; but it is said that they were all taken out during the Revolution and the first Empire, and that the forest has never been allowed to recover. The lower portion, where we entered it, is now stocked with *Quercus Ilex* and *sessiliflora;* the former cut at a young age for tanning bark, and the latter, worked as a simple coppice, being cut at the age of twenty-two years for conversion into charcoal. Bark and charcoal can be profitably exported, the gross annual revenue from these sources being about 3*s.* 3*d.* per acre; but there are very few roads now existing in this locality, and it would not pay to export firewood; so that the small wood, which cannot be utilised for charcoal, is left upon the ground, where it rots in a couple of years or so. The heads of the Department are anxious to raise a high forest of pines in place of the present crop, but the local officers are opposed to this project, as they are afraid of fires. The charcoal is burnt during the winter, so as to avoid danger from this cause.

Regarding this part of the country, generally, it may be said that the rock is limestone, the principal trees being the Aleppo pine and the evergreen oak; the ground is steep and difficult, so that the forests do not yield much. There is no doubt that timber of large size grew in former days on these hills; but at the end of last century the country fell into disorder, M. Madon's grandfather, who then occupied a high official position, having to go about under the protection of a pair of ferocious hounds, and having to treat with brigand chiefs for safe conduct through it. At that time the people were not under any sort of control, and the entire district became denuded of trees, from which condition it seems almost impossible that it can ever recover; for the ground is owned principally by communes and private proprietors, who cannot afford to refrain from cutting in order to allow the forests time to grow up. They have to pay taxes, and must get revenue; while the stock being very small, it must be worked over at short intervals, and no accumulation of capital is possible. Say, for instance, that the forests yield a gross revenue of 3*s.* 6*d.* an acre, the cost of working, with maintenance and taxes, comes to something like 2*s.* 6*d.*, and not much saving can be effected out of the balance. But it would be a very great advantage if the State would set an example, by showing the people what the soil is capable of producing under proper treatment; and

a portion, at least, of every State forest in this region should, for this, if for no other object, be brought as soon as possible into a good condition. In most mountainous districts the fairly level ground is cultivated; but forests grow well on slopes up to 35°, the working out of the timber being both difficult and costly when the fall is much greater than this. Such steep ground had better be kept under simple protection, letting the forest grow up as much as it will, removing none but dead or dying trees, and spending time and money on those parts of the area only which are likely to pay well. At Montrieux, for instance, there are said to be 1,100 acres of rocky ground, which, if left alone, would grow a light crop of trees, affording protection to those on better soil, and at the same time giving seed; here all efforts should be concentrated on the remainder of the forest, so as to bring it into the best possible condition, as an example to be followed by degrees by the neighbouring proprietors. The moral to be learnt from a study of these hills is that all existing forests should be most jealously guarded against the destruction, which must sooner or later over-take them, if they are not rigorously and efficiently protected against over-cutting, fires, and grazing. When once they have been ruined, those which are not State property can hardly ever be resuscitated, and even if success be attained it is at an enormous cost. While we were pondering on these questions, the rain, which had been threatening for some time, burst upon us with the violence of a tropical shower, and we had to find our way to Belgentier in a drenched condition, down a path which was converted for the moment into a little torrent, through which we had to wade. On arrival we found that, to make matters worse, our carriage had not arrived, and we had to wait an hour for it to take us back to Toulon.

The Maures.—From Toulon we took train to Cuers, in order to visit the Maures, a low range of hills rising to a height of 2,500 feet, near the sea-coast between Toulon and Fréjus. This range, which has precisely the same geological formation as the Vosges, is extremely like them in appearance; the rock is principally granite, gneiss, or mica-schist, and there are numerous springs throughout it. The chain is continued beyond Fréjus by the hills of the Esterel, which extend eastwards to Antibes, and differ from the Maures in that the rock is chiefly porphyry, the numerous clefts and cracks in which permit the water to drain off with rapidity, and hence the soil is dry, poor, and shallow. The abrupt cliffs which mark this part of the range form a noticeable contrast to the rounded, grass-grown summits of the Maures.

This region is protected from the cold north winds by the Alps, but receives the warm Mediterranean breezes; and hence the climate is very mild, permitting the culture of the olive and orange, as well as of the vine and cereals. Wherever water is

found in sufficient quantity, pasture is practised very extensively; but this is not possible everywhere, and large areas are maintained under forest. The vegetation differs very much from that of the north of France. Here we find among the larger trees the Aleppo pine and cluster pine (*P. pinaster*), with the stone pine (*Pinus pinea*) growing occasionally near the sea; and among broad-leaved kinds we have the cork oak (*Q. suber*), which is not found elsewhere in France except in the Eastern Pyrenees, the Spanish chestnut, which is grown for the sake of its fruit, the pubescent variety of *Quercus sessiliflora*, and more rarely the ash and maple (*Acer campestris*). Among shrubs there are the wild olive, the dwarf oak, the juniper, the arborescent heather (*Erica arborea*), the arbutus, oleander, broom, and others; while among smaller plants may be mentioned the common heather (*Erica scoparia*), myrtle, lavender, cactus, and cistus, *Chamærops humilis* and the date palm flourish in this locality, and distinguish it botanically from the rest of France. It is the region of conifers and of the cork oak, the produce from the latter being exceedingly valuable, and increasing in price every year.

An omnibus met us at Cuers, and carried us some miles on the road towards Collobrières, where we were to pass the night. We stopped for a few minutes at Pierrefeu to look at the country. The village, which is built on granite rocks forced up by volcanic action, overlooks an extremely fertile cultivated plain, across which we saw, towards the north, limestone mountains of the same formation as those we were on the previous day, the plateaux and steep scarps of which reminded us of the Jura; while towards the east and south the rounded tops of the Vosges-like Maures were visible. The numerous spurs constructed to keep the stream within its bed showed us that we were no longer on the limestone. Here, in the Maures, the slopes rarely exceed 30°, and the construction of export roads and work of all kinds is consequently comparatively easy. After driving a little further we left the road, and mounted the hill-side through a forest of pines, partly Aleppo and partly cluster, with some evergreen oak in places, and a dense growth of the arborescent heather. The forest is communal property, and its area is about 7,500 acres. The cluster pine cannot here be grown profitably for resin, as the soil is too dry to produce it in sufficient quantity; the pines are, therefore, felled under the selection method, at a minimum girth of 3 feet 8 inches, and are cut up into planks, the price per tree in the forest being 4*s*. The evergreen oak is worked for bark as a simple coppice. A little further on we came upon some cork oak, and the number of that species increased as we advanced. This tree constitutes the principal wealth of the country, the crop being a very profitable one, as owners of cork forest are able to count on a revenue of 25*s*., and get, in rare cases, as much as £19 an acre. Such forests,

of course, cannot be bought under a very high figure. About this part of the Maures the State does not possess much of the forest, about 37,000 acres being owned by private proprietors, and about 7,000 acres by village communities. Communes possessing forests of this kind have large revenues, and as a rule they have constructed fine roads and bridges out of them; but it is remarkable that, their credit being good, they are nearly always heavily in debt, Pierrefeu being said to have an annual income of £2,000 a-year, while its debt amounts to about £15,000. We were told that ten or a dozen of the inhabitants of Collobrières possess fortunes amounting to £40,000, one of them having £200,000, all made by cork and Spanish chestnut, of which large quantities are grown higher up the valley. These men are content to wear blue blouses, and to live in the same style as their poorer neighbours.

M. Madon described to us the method of treating the cork oak. The removal of the cork is effected as follows:—An annular incision is made near the base of the tree, and another at a height of about 4½ feet above it, these being joined by a third incision carried vertically down from the upper to the lower one. Great care and long practice are necessary to enable the workmen to perform this operation without cutting into the matrix. The cork is then raised with the blade of the axe and the wedge-shaped end of the handle, and if it does not come off well it is struck with the back of the axe-head to loosen it; but this again must be carefully done to avoid injuring the matrix, on which a new growth of cork is to form. The layer of cork first taken off is of no value; nothing can be made of it. The second and subsequent growths, which are comparatively smooth, and form the cork of commerce, are removed when they have attained a thickness of nine-tenths of an inch —that is to say, after intervals of from six to ten years. May and June, when the trees are in full sap, are the months usually chosen for this operation. After the lower ring of cork has been removed, a second one is taken off higher up, and so on up the trunk of the tree and its lower branches. In the case of trees of small girth, the addition of an inch to the radius involves a greater proportional increase in the circumference than it does in the case of large ones; and the cork growing to that thickness on small trees is liable to crack and split into vertical furrows, which, when they are irregular, greatly diminish the value of the cork. On this account it is usual to make two vertical incisions on opposite sides of the young tree, which gape wide with its increasing growth, but which avoid the formation of the objectionable, irregularly-shaped, natural furrows that would otherwise have been formed. The rule is to take off only one ring at a time, and to allow the tree an interval of two or three years' rest before attacking it again; but this wholesome restriction is not always observed, and it is

not uncommon to see trees which have been stripped, at one time, of their covering of cork throughout the greater part of their stem and large branches, this leading frequently to the deterioration or even the death of the tree so ill-treated. Trees that have been barked in the manner above described, present a peculiar appearance, the cork of different ages having various colours, from the red of the youngest to the grey, rough, moss-covered natural growth on the upper part of the tree. Experts can tell the age of the cork by its colour and general appearance. The outer surface of the second and subsequent growths of cork, though smooth and clean by comparison with that of the natural layer, is hard and gritty, and has to be scraped off. This causes a loss in thickness; and a system has been devised by M. Capgrand-Motte, under which the growing cork is protected by a covering—a sort of jacket, in fact. This method was highly thought of at first, but it is now believed to be the cause of a fungus growth which has appeared on a large proportion of the trees so treated, and it has been abandoned.

The trees are nearly all coppice-shoots. Stems of less than 16 inches in circumference are not worked. It is said that a seedling tree will not here attain this size in less than forty years, whereas a coppice-shoot will do so in fifteen years. The collection of cork from the forest we visited has now been going on for about sixty years, and it is believed that the trees can be worked up to a great age. The yield per tree depends of course on its size; but it has been calculated that a square foot of matrix yields on an average 1½ lb. of cork every eight or nine years. The price is very variable, rising sometimes to 50s. per 100 lbs., but more ordinarily the rate is 25s., the cost of collection being 3s. 6d.

The financial difficulties in which most of the communes are involved, lead to the result that, notwithstanding the intervention of the Forest Department, their forests are not, generally speaking, kept in such good order as those of private proprietors. It is a common practice with them to farm out the collection of cork on twelve-years' leases; but this, generally, or at any rate frequently, leads to the contractors taking off all the cork of marketable thickness in the last two seasons, and handing back the trees in a condition in which they cannot yield much more for several years. The system should be discontinued.

The cork oak is a tree of light cover. Here it grows mixed with the cluster pine; but there can be no doubt that the proportion of pine, which tree is of very small value as compared with the oak, is far too large, and that the cover is in many places too heavy, so much so that the development of the oaks is seriously impeded, while in places they have been completely killed, many of the pines being also dead, and left standing at the risk of their breeding insects. That the cork oak does not

entirely disappear under this treatment, is due to the fortunate circumstance that it can support a fairly heavy shade without actually dying outright; and that under it the trees continue to live in a stunted and unhealthy condition, giving a certain amount of seed; so that, except in the densest parts, there are nearly always some suppressed oaks of various sizes, even where the heather is very thick. We passed a piece of private forest in which precisely the contrary conditions prevail, the whole of the pines having been cut out, and a pure oak forest remaining. This has resulted in a very rapid growth of the young oak, and possibly it may turn out to be the correct method of treatment; but the opinion of the Forest officers present seemed to be that it should not be generally adopted, for the present at any rate, both on account of the objections which exist to the maintenance of pure forests on general grounds, and also because, however well the oaks might grow, if left to themselves, without the shelter of the pines, it is by no means certain that they would prosper equally well when deprived of the shields of cork, with which nature has furnished them, doubtless to enable them to resist the fierce heat of the southern sun. It seems likely that under these conditions it is necessary to afford them some shelter, and that complete exposure, by the entire removal of the pines, will not have a good result. The proper plan seems to be to leave just enough pines to afford the needful shelter, and no more; certainly the cover of these trees should not be allowed to suppress the oaks.

(To be continued).

FIRST IMPRESSIONS OF BURMA.

HAVING many friends in India, of whom some have just come out from home like myself to join the Forest Department, while others are already engaged in the various branches of the Civil and Military services, I thought the best way for me to communicate my experiences to them would be through the pages of the "Indian Forester." Under these circumstances I hope my readers will bear in mind that the following sketch really does set forth my first impressions, so that the criticisms of brother officers in Burma, who have lived and worked in that country for long years, will not be too severe on my audacity and inexperience.

I propose then to relate what I actually did and saw on a week's tour during my first month in Lower Burma.

But before setting out, it is only right that I should say a word about the station at which I am posted. It is a pretty little village on the Irrawaddy, the houses being ranged along the river bank, where they are beautifully shaded by palm trees; at this season the river drags its slow length along some 50

feet below the top of the bank, but in the rainy season, were it not for an embankment which runs all the way along, the whole country would be flooded, and for this same reason all houses are built on piles from 2 to 8 feet off the ground.

My work here is mainly to superintend drift operations on the river, as immense numbers of rafts of teak are floated down almost daily, the greater part of them belonging to the Bombay Burma Trading Corporation, Limited. These rafts have to get their passes examined at certain places on the river, of which my head quarters is one. Another reason, I believe, for my being sent here was that there is a proposed reserve of teak on the range of hills which separates Pegu from Arakan, but owing to the unsettled state of the country the work of demarcation has to be deferred.

It was on a cold misty morning that I left my bungalow with a small retinue, composed of one Ranger, four Forest guards and two servants, all on foot, as I had not yet been able to find a suitable pony; and as one can never be sure of not coming across dacoits, I carried my own shot gun myself, while my men had three old muskets which I had borrowed for them from the Police. The country we went through was all paddy fields, which are tedious to travel over, and offer no diversions of any kind, except a stray shot at a vulture or other bird as yet unknown to the débutant. Some eight miles of this brought us to a village where we waited till the bullock carts arrived and then had breakfast. Meanwhile the inhabitants were having some sort of festival, and trotted out a great god of bamboo and pink paper before the house where I was, and there danced and played and gave me presents of plantains, melons and sticks of bamboos containing cooked rice.

In the afternoon I started out again, and at six o'clock arrived at a small Karen village, where we should have arrived some time before if we had not taken short cuts. Here I found a French Missionary with his house and chapel surrounded by a strong stockade to keep out dacoits; being a native of Lorraine, he was able to talk of Nancy and old times, and so we passed a pleasant evening after the day's march.

It must require a considerable amount of devotion to lead a life like this, I think, for these Missionaries are no carpet knights, but live in utter poverty, obscurity and solitude, with scarcely any prospect of ever returning to their native land.

The next morning my host gave me a lot of information about the neighbourhood; how they tap some trees to make torches, strip others to make ropes, and commit even more serious offences. I found that he had distributed copies of the Forest Act in Burmese among his people, so that they at any rate should know the law. It is often said that the rules are unknown and impossible for the people to understand, though I must say I can see no difficulty in them myself.

In the afternoon I went out on to a lake close by, and found there plenty of teal, also quantities of another large blue bird resembling a water fowl, but these latter were too tame to be worth shooting; the teal, however, were wild, which shows that the Burmans have learnt to appreciate their excellence.

Next morning I set out very early to escape the heat of the day, and just after starting heard the Angelus softly ringing over the tangled forest, where it mingled with the shrill crows of the jungle cock and the chirping of the crickets on the tree tops. This march was a very agreeable one, the road lying through shady forest and taungya plantations; I found several jungle fowl and bagged a couple for breakfast.

The Karens in these parts still use the cross-bow, with which our forefathers are said to have done such execution; it is a very formidable weapon, and a bamboo arrow shot from one would pierce a deer, or man even, with ease: I watched them shooting squirrels, at which they are very clever.

This night I slept in a large village where a detachment of sepoys are now stationed, as the scene of an outbreak of the dacoits last year, when the police station was burnt. There is one great convenience that one meets with in travelling in Burma —or at any rate in these parts—and that is that one finds every where rest-houses built by pious Burmans for wayfarers, which, with the help of a few curtains from the village, form as good a home as one can want in camp; and even where there are no good rest-houses available, one can always put up in a Burman's house, where the proprietor is delighted to turn everything inside out to make one comfortable, and gives one everything of the best he has. I believe in India it is far otherwise.

The next morning I had an enjoyable ride through a very wild jungle, where the cocks were crowing all round us, and here I was lucky enough to come across a brood of wild chickens, of which I captured a couple to bring up at home. The village I finally arrived at is on the extreme limit of civilization, being at the foot of the Arakan Yeoma, on which one sees never a vestige of human habitation. Some mounted police are stationed here, and other parties are posted in some half dozen similar villages between which they patrol daily, so as to form a cordon to keep out dacoits. I was happy in finding three Police officers here, with whom I went out shooting in the evening, but we only got one hare and some jungle fowl, of which the greater number fell to my own gun.

But beside shooting, I had other objects in coming here. Before leaving head quarters, I noticed in a large village on the river some dozen or twenty houses occupied in making rope from *Shaw* fibre collected in the jungles where I now was, and seeing that by stripping off the bark the tree is killed (albeit useless for timber), while the people pay some 12 or 18 Rupees per 350 lbs. I do not see why they should not pay a small duty

on it as for other kinds of forest produce which form articles of commerce, such as cutch and wood-oil.

A second reason for coming here was that an alleged coal-mine had just been discovered; so early next morning I rode some four miles up a dried-up stream into the hills; here we found the forest primeval, but stripped of all its leaves which strewed the sun-parched soil, from which however delicate white crocuses thrust their heads, while in still greater contrast orchids of rare beauty drooped from the leafless boughs making an exquisite picture of still life.

After passing a precipitous rock, on the summit of which I was told the Chins have for long ages buried their dead, the guide lead us up a small nala, and presently brushing away with care the dead leaves covering the bank, revealed the coal mine, which was no less than a handful of black dust in the bank side. I turned homewards and galloped in to breakfast.

In the evening I rode six miles to another village with one of the Police officers, where we found a large deserted house, and made ourselves comfortable for the night. Next morning I went and marked six tons of dry teak, which had been collected in the jungle, and were being worked by a large timber merchant. Afterwards we had some rifle practice with my ·577 express at 300 yards, with great success, though for sporting purposes I fear it is much too heavy for Lower Burma.

In the evening we had a beat and found plenty of jungle fowl and black partridge. I also shot a deer under rather strange circumstances; the beat was over and the men had closed in round me when the deer came charging through from behind right up to my interpreter, to whom I had given an old musket, with directions to fire at deer if he got the chance; well, he did fire and missed of course, whereon the deer came on to me, and I, having no time to change cartridges, gave him a charge of No. 4 which failed to stop him. I instantly started another beat hoping to get him, but before the beaters had gone ten yards they found the deer stone dead, three of my pellets having reached his vitals, so he was slung up and brought home in triumph.

My next stage brought me through some Shan villages to a small town on the river bank, where a lot of timber is consumed for boat-building. The Burmans here have a very ingenious way of making their canoes, though I dare say the same method is practised elsewhere. The first time one sees these boats, one would think they were simply carved out of a huge log some 3 feet 6 inches in diameter, as it is all of one piece, except sometimes when a thin plank is laid along the edge to make the boat deeper. The method employed is as follows:—A log of green pyinkado, some 25 or 30 feet long and 18 or 20 inches in diameter, is roughly hollowed out, except at the two extremities, where it is left solid for a foot or two: a fire is then lighted

underneath, so as to heat the bottom, but without burning it, the inside being meanwhile basted with cold water: fork-shaped pieces of wood are then placed on the edges of the boat, to which are attached levers which are pressed down gradually for some ten days and tightened by ropes, while sticks are laid across the boat inside to hold it open; in this way the sides are bent outwards until the original span is doubled. The whole process takes about ten days, after which time the boat in section forms a regular semicircle of about 3 feet across, which shape it retains indefinitely. These boats fetch from Rs. 30 to 50, and are immensely used,—each household having at least one of them, to supply the only possible means of locomotion during the floods. These boats, however, have the drawback of sinking when full of water, the wood being very heavy, but this can be remedied by fastening a bamboo along each side which renders it quite safe, but at the same time diminishes the speed.

I marked about fifty of these boats, beside a lot of logs and planks, and so had no time that day to go out shooting; though I was told that by going out in the early morning one could be sure of getting some deer in a place close by.

The next day I went and visited a cutch-boiling neighbourhood. These places look very weird, as one first distinguishes through the morning mist the cauldron seething in a cloud of smoke, but perhaps I may as well describe the entire scene.

In front of the hut where the cutch boiler lives, a trough is dug in the ground some 8 inches deep in the shape of a horse-shoe; the trough is filled with chips of wood to serve as fuel, while on it are placed from 20 to 30 pots or oil tins, filled with chips of the cutch wood, which are chopped about an inch square, and pressed down tight into the pot: water is then poured in, and the wood underneath is lighted. After boiling thus for a short while, the liquid is decanted into a large pan, which is boiling over a separate fire of greater heat, and as the liquid in this cauldron boils away, it is replenished from the smaller tins from time to time, until the required degree of viscosity is arrived at, when the cutch is taken out and put into a box where it cools and hardens.

Each cutch-boiler pays an annual tax of Rs. 20 to Government for each cauldron he has working, and in a good day's work he may make one panful, which weighs about 35 lbs., and is worth about Rs. 4. Cutch already forms a very important item in the revenue of the Forest Department, and in this district at any rate it certainly might be made to give a good deal more than it does.

The Subordinate staff here is utterly inadequate to the work, both in number and quality.

In the jungles the villagers can do whatever they like, without running much risk of ever being disturbed by a forest guard. Besides, the pay of a forest guard is only Rs. 12 a month, which

is not sufficient to supply the bare necessities of life, they would get better wages as coolies. Moreover, they are mostly married men, and honesty becomes a moral impossibility, the result being that the revenue is about half what it ought to be, while an unscrupulous guard can make his hundred a month. But to return. After examining the cutch licenses I made for home, and on my way passed a village which had been burnt by dacoits the night before, and presented a scene of utter desolation.

One old woman had not been able to escape from her house, and perished in the fire, and I saw a young fellow who had been fearfully cut about with *dahs*.

The last incident of this expedition was of a still more painful character—to me. The pony I had been riding a week, I had borrowed by proxy the first day of my tour, so I did not even know who the proprietor was. I was gaily trotting along the road, coming into a village about 6 miles from home, when suddenly the pony showed a frantic desire to plunge down the embankment, I resisted and a struggle ensued, which presently terminated in finding myself on my back against the door of the pony's home, when I got up and walked sadly to my camp.

BURMANICUS.

CODE HEADINGS.

I THINK it is time that some decision should be given by high authority as to what constitutes the difference between I. or departmental work, and II. or non-departmental work.

I had hitherto been under the impression that the distinction lay in the *removal*, and the Code Forms seem to confirm that impression, for they still describe R I. and A I. as "timber and other produce *removed* by Government agency;" and R II. and A II. as "timber and other produce removed from the forests by consumers and purchasers."

I was told the other day, on very good authority, that the real distinction lay in the *cutting:* that if Government spent a single pice on *cutting* the material, the charge should go to A I. and the revenue to R I.

If this is the case, it ought to be more generally known, for in my Province, I am sure, that after Government money has been spent in *cutting* material, which has been sold at once before removal, and then removed by the purchasers, the revenue has been credited to R II.

In olden days, the distinction between I. and II. was very clear. Probably the type that the first compilers of the Code had before them was of I. work, the departmental work in the hill divisions of the Punjab, where every stage of the work, the felling, logging, sawing, shooting, carrying, rafting to depôt, &c., was done entirely by Government from beginning to end.

And perhaps the type of II. work was taken from the khám tahsil system at that time obtaining in parts of the N.-W. Provinces, where not a penny was spent under A II. except in the form of establishments, while all the revenue went to R II. with no guarantee of reproduction.

Since those days, however, the two types have considerably approached each other, and under the so-called khám tahsil system, we now see restrictions of every kind, fire protection, closed blocks, reserved species, trees felled under supervision, trees marked by the Department, &c.; and under I. in the form of improvement fellings, we see Government conducting the felling, and disposing of the produce sometimes by direct sale to purchasers before anything has been fashioned or removed, sometimes after removal from the coupe only, and sometimes by carriage to a sale depôt.

But the way in which the question affects the Department is this. Many people, Secretaries of State for India, India Offices, and perhaps even Indian Finance Committees, judge us by the results under the two comparative systems. The two systems are still under comparison, and on probation as it were. Should it finally be decided that II. is better than I., then I. must be abandoned, and *vice versâ*.

Hitherto, the comparison has been unfavourable to Departmental work; and if we continue putting our charges to I. and our receipts to II., we increase the unfavourableness of the comparison to departmental working.

If such things have hitherto been done, they have been done in ignorance, and from adhering to the word "removal."

If the cutting is the proper distinction, then the sooner the proper authority speaks the better, and alters the wording of the Budget sub-heads.

SCARABÆ.

TIGER AND PEAFOWL.

It is perhaps generally thought that the presence of peafowl on the ground indicates that there is no tiger in the immediate vicinity, but the following tale will show that such cannot be relied on, and how I lost a chance of bagging a magnificent tiger through the untimely warning of a peafowl. I was camped near the river Nerbudda, and it was the hot season when the fires had already passed through the forests, and laid the ground everywhere as bare as a rock. I had with me a couple of local shikaries of the kurku caste, whose capabilities as sportsmen are perhaps unrivalled by those of any other caste; at any rate these two men were first class in tracking up and finding game, and could be relied on for an emergency. When starting for work one morning I told one of these kurkus to cast his eye round for game. On my return to camp about

midday I found him awaiting my arrival, and a twinkle in his eye showed that he had good "khaber," and sure enough he had been looking from a ledge of rock at a huge male tiger fast asleep in a pool in a gully below not 15 feet distant. I asked him why he had not fired, for I had given him my 10 bore rifle—the faithful old chap (he must have been fifty or more) replied he would not dare to spoil saheb's sport. Well! after a hasty meal we set out—it was only a distance of a couple of miles. On arrival at the spot, knowing from experience the "luck" that attends tigers, I proposed that some one should be posted in the ravine above, but my old companion was so "cock sure" of the whole concern, minutely explaining how he had sat for a good while watching stripes, and had examined the locality, &c., that I gave in. On nearing the ledge I took off my boots, and went along very warily determined to have a good view of beauty before firing, and I had only another five paces to reach the point, when up flies a peahen from actually the very place where the tiger was sleeping. I rushed forward, but only to see marks of his wet paw on the rock as he bounded up the ravine,—and he was seen by those behind making tracts clear away into the wide forest. It was indeed a most perfect spot to have caught old stripes, and I might have looked at him at quite close quarters for hours and then potted him at my leisure, but his time had not yet come, and I returned somewhat down with my luck.

20th April, 1887. D.

GRADING OF FOREST RANGERS.

I BEG to send you the following few lines, and hope you will publish them in the "Indian Forester."

It appears from the last issue of your valuable Journal, that Forest Rangers in the North-West Provinces are placed on the same status as Inspectors of Police. But the case is quite different in the Punjab. The Rangers there have as yet no recognized status, though much protective, as well as revenue, work is required from them. They come in contact with Police as well as Revenue officers, perhaps more frequently than they do in the North-West Provinces. In the Vernacular Government Gazette they are designated as "Girdáwar Jangli."

In the Revenue Department, Girdáwars draw about Rs. 20 or Rs. 15 per mensem, and hold positions under Tahsil Canongos. So the translator considers that Forest Rangers are of the same status as Girdáwars. To the misfortune of the Punjab Rangers, he further adds the word "jangli," which may mean that the Rangers are *illiterate* or *savage*, or something of that sort. "Girdáwar Jangli" does not convey the proper idea of the duties expected from Forest Rangers. If the Rangers of the

Punjab do not deserve any recognised status, they may be spared from the designation of "Jángli Girdáwar."

A Reader.

MALJHAN FIBRE FOR PAPER MAKING.

The Secretary of the Lucknow Paper Mills informs us that it will not pay to use the Maljhan* fibre for white paper. This fibre takes a lot of caustic to boil, and also a very large quantity of bleach. They can only use it in making brown papers, and will pay a rate of Rs. 1-6-0 to 1-8-0 per maund, delivered at the Lucknow Railway Station. Their yearly consumption will probably be 3,000 or 4,000 maunds.

PLANIMETERS.

I think it will be useful to suggest that all Divisions that are provided with maps should also be provided with a planimeter to take out the areas of fires. The returns of fire conservancy suffer, I feel very sure, from the habit of finding the areas by rough and ready means, and moreover these rough and ready means are in reality only rough means, and not at all ready, since the planimeter is very much more quickly worked. The instrument would also be useful in a hundred other ways.

Q.

CLEARING CONTOUR BANDS THROUGH DEODAR FORESTS.

Your P. D. is napping again. At page 225, Vol. XIII., May number just received, he makes me say "and the soil is also prepared or worked up; near seed-bearers large blanks are planted." Now seeing that I am strongly in favor of doing as little planting as possible, I should not be likely to plant "near seed-bearers" of *all places in the world!* The semi-colon should be after the word "seed-bearers," and the meaning will be entirely altered.

J. C. McD.

M. Reuss has requested me to notify, through the medium of your columns, that his work on the International Forestry Exhibition, held at Edinburgh in 1884, is procurable at Berger, Levrault and Cie's, Nancy; the price is 3·75 francs = 3 shillings.

Fred. Bailey.

* *Bauhinia Vahlii.*

III. Notes, Queries and Extracts.

The Box.—*Nomenclature.*—This is the *Buxus sempervirens*, the evergreen, or common box tree of Linnæus. The word "buxus" is derived from *paknoe*, dense, in reference to the hardness and closeness of the wood; or, perhaps, to the denseness of the foliage. The Greeks called the boxes made of this wood, which were highly esteemed for their durability, *pyxide*, and hence probably arose the word *pyx*, which is used for the chest containing the host, in the Roman Catholic Church.

It is the *bois commun* and *bois beni* of the French, and the *Buchsbaum* and *Buxbaum* of the Germans.

Geography.—The box is a low evergreen tree, a native of Europe and the temperate parts of Asia, and, according to some authorities, of Britain, growing to the height of 15 feet to 30 feet. The tree is found in a wild state between 31 degrees and 52 degrees of North Latitude, on mountains, and spreading as undergrowth among other trees; but never forming forests entirely by itself. The largest collection of wild box trees in Europe is in the forest of Ligny, in France, and in that of St. Claude, on Mount Jura; but in both cases the box trees are mixed with trees of other species. Box trees are also found in forests of other trees, in several parts of France, particularly in Franche Compté, Dauphiné, Haut Provence, the chain of mountains stretching across Languedoc, and the Pyrenees.

The box tree is produced abundantly in Turkey and on the shores of the Black Sea; but a great proportion of the boxwood of commerce sold in the European markets as Turkey box is grown in Circassia and Georgia, whence it is brought to Odessa, and shipped for Europe.

The box tree is found in various parts of Persia, India, China, Cochin-China, and, according to some, in Japan.

In England the box tree is a doubtful native. It grows plentifully upon Box Hill, near Dorking, in Surrey. In a lease of this land, dated 25th August, 1602, the tenant covenants to use his best endeavours for preserving the yew, box, and all other trees growing thereupon; as also to deliver, half-yearly, an account of what hath been sold, to whom, and at what prices. The receipt of box trees cut down in 1608 upon the sheep-walk on this hill amounted to £50. At present the only habitat of this tree in England is at Box Hill, and, though this circumstance cannot be considered as a proof that it is not indigenous,

yet, as it is well known that it does not ripen its seed freely in this country, and seldom sows itself, either on Box Hill or anywhere else, when in a neglected state, we may fairly be allowed, when these circumstances are taken into consideration, and conjoined with its Roman name, to doubt whether it be a native.

History.—The box tree appears to have been first mentioned by Theophrastus, who ranks the wood with that of ebony, on account of the closeness of its grain. Pliny describes it as being as hard to burn as iron, as producing no flame, and as being totally unfit for charcoal. Vitruvius, Pliny, and Ovid allude to it for topiary work, or its wood for musical instruments, and the name of the tree being synonymous with that of flute. Virgil calls it:

> "Smooth-grained, and proper for the turner's trade,
> Which curious hands may carve, and steel with ease invade."
> Dryden's *Virgil.*

The wood of the tree has been in use for turnery from the earliest ages, and for wood engraving since the fifteenth century.

Description.—The wood of the box is remarkably heavy, weighing, when newly cut, 80 lbs. 7 oz. per cubic foot, and, when perfectly dry, 68 lbs. 12 oz. It is the only European wood that will sink in water; it is yellow, very hard, and susceptible of a high polish. The wood was formerly much used in England in cabinet-making and inlaying, as it still is in France; and also, in both countries, for musical and mathematical instruments, combs, and various articles of turnery. The principal use of the boxwood is for wood engraving, and for this purpose it is an important article of commerce.

The boxwood used by cabinet-makers and turners in France is chiefly that of the root. The town of St. Claude, near which is one of the largest natural boxwoods in Europe, is almost entirely inhabited by turners, who make snuff-boxes, rosary beads, forks, spoons, buttons, and numerous other articles.

The wood of some roots is more beautifully marbled or veined than others; and the articles manufactured vary in price accordingly. The wood of the trunk is rarely found of sufficient size for blocks in France, and when it is, it is so dear that the entire trunk of a tree is seldom sold at once, but a few feet are disposed of at a time, which are cut off the living tree as they are wanted.

There are in the forest of Ligny generally many stumps which have been treated in this manner.

Boxes, &c., formed of the trunk, are easily distinguished from those made of the root, by the wood of the trunk always displaying a beautiful and very regular star, which is never the case with that of the root.

Seasoning.—Boxwood is very apt to split in drying; and, to prevent this, the French turners put the wood designed for their

finest works into a dark cellar as soon as it is cut, where they keep it from three to five years, according to circumstances. At the expiration of the given time, they strike off the sapwood with a hatchet, and place the heartwood again in the cellar till it is wanted for the lathe. For the most delicate articles, the wood is soaked for 24 hours in fresh very clear water, and then boiled for some time. When taken out of the boiling water, it is wiped perfectly dry and buried, till wanted for use, in sand or bran, so as to be completely excluded from the light and air. Articles made of wood thus prepared resemble in appearance what is called Tunbridge ware.

Engraving blocks.—The wood used for engraving purposes is chiefly imported from Turkey or Odessa, and sells in London at a very high price. Its use has been much on the increase since the repeal of the paper duty and the development of illustrated literature. In 1832 the duty alone on this wood amounted to £1,867 17*s.* 4*d.* In France the native trees are seldom of sufficient size for wood engraving, and wood is largely imported from Spain. The box trees which were cut down on Box Hill in 1815 produced upwards of £10,000.

The art of cutting on wood was first practised between the years 1400 and 1430, it being first applied to books of devotion and playing cards. It was essentially a German invention, the wood engravers being called *Formenschneiders*. Until the time of Bewick, the celebrated English wood engraver, the blocks were cut in the manner of boards from the tree, the engraved lines mostly running with the grain of the wood. At the above date the custom of cutting the trunk into sections about 1 inch in thickness was adopted; the advantages of this mode are such that engraving on wood has largely superseded engraving upon copper and steel. The large engraving blocks used for the principal illustrated papers are formed, or built up, in pieces of various sizes. This is a special trade, and one in which the greatest judgment and skill are exercised. On completion the face of the blocks is smoothed or polished and prepared with powdered white lead and water, upon which the artist makes his drawing, the business of the engraver being to cut away the white parts, and leave the black lines of the artist's pencil in relief.

Concluding Remarks.—The great demand for boxwood, not only for wood engraving, but for turnery, tools, mathematical instruments, &c., is pressing so heavily upon the supplies from Europe and the Black Sea districts, that other markets are being sought, prominent in which is our Indian Empire, where considerable quantities are found in a wild state. The experiments in this direction have not been successful, owing to the expense of winning it from its native haunts, conveying it to the sea-coast, and transporting it to England. The samples of wood reaching our market from this Eastern source have not

been felled and treated with the same care as those regularly coming into this market from Turkey; this, coupled with the additional cost of getting it to the European market, has caused the experiments to result in little better than loss, but it is an undoubted fact, as the old source of supply becomes weaker, that the Indian box wood will assume a prominent place in the trade.—*Timber Trades Journal.*

Extract from the "Gardeners' Chronicle," Vol. I., Third Series, No. 1, (1st January, 1887,) page 21 :—

TRANSMISSION OF SEEDS FROM THE TROPICS.—Mr. Hart's note (p. 756, Vol. XXVI.) goes a long way beyond the assertion of M. Thiery (see p. 497), the latter pointing out that in the tropics, seeds of European plants lose their vitality much sooner than in Europe, which seems precisely what might be expected to happen, although the difference as, for instance in the case of the seeds of cabbage, *viz.*, eight months in the tropics and eight or ten years in Europe, and peas, four months against four years must be unusual.* Mr. Hart, however, seems to recommend hermetically sealed packages or packets for all seeds sent to the tropics, and condemns the paper bags generally used. Our experience at Kew, is of course, of a different nature from that of any one in the tropics, but we receive thousands of packages of seeds of all kinds annually from all parts of the world, and we send to the tropics almost as many. The safest and most successful method of packing to adopt for seeds sent from Kew to the tropics, and *vice versâ*, is therefore a matter of much interest here. Seeds badly harvested are not likely to stand a long journey, no matter how they are packed, but if gathered at the proper time, carefully dried and stored till ready for sending away, we believe the great majority of seeds travel best in paper packets, and these in a canvas bag, if to be sent by post. Large quantities of seeds may be sent in an ordinary box, but they should be stowed in a dry place on boardship. Seeds of an oily nature ought to be packed in damp soil as soon as they are ripe, and if the journey is not very long, they will grow when taken out of the soil and placed under favourable conditions. Even oily seeds will sometimes bear exposure to air and drought without suffering. We lately received from Demerara, a quantity of seeds of *Hevea spruceana*, which arrived quite dry, having been sent in an ordinary box; I believe every one of those seeds germinated, very much to our surprise. Palm-seeds of all kinds, except, perhaps, *Nipa fruticans*, travel well if sent in ordinary canvas bags. The Right Hon'ble Sir M. E. Grant-Duff, late

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* Seeds of kidney beans, kept for two years in Jamaica, germinated freely when sown; peas are supposed to retain vitality at least as long as these do in England, *viz.*, three to five years.

Governor of Madras, has forwarded thousands of packets of Indian seeds of all kinds to Kew within the last four years, and these were all packed dry, the packets (paper) being first bundled and enclosed in card-board to keep the seeds from being injured in the post, and then rolled in a canvas or paper wrapper. The bulk of these seeds have been sent on from Kew to the Colonies, but almost every one of those kept at Kew, germinated well. Sir F. Von Mueller, also sends many kinds of seeds from Australia, always in paper packets and almost always successfully. Certainly at Kew, we have every reason to prefer the paper packet and canvas bag to all other wrappers for use in the transmission of seeds generally to the tropics. With regard to the preservation of imported seeds, the circumstances here at Kew are the reverse of those referred to by M. Thiery and Mr. Hart. The difficulty of preserving tropical seeds in England must be less than that of preserving European seeds, such as peas, beans, &c., in the tropics. We do not require to keep many tropical seeds for any length of time, seldom more than a year, except in the case of cucurbits and cacti, but we do not find that seeds kept in paper packets in a drawer, where the atmosphere is dry and the temperature about 60° in winter, lose their vitality within that time. Exceptional cases are of course excluded; there are many kinds of seeds which perish almost as soon as they get dry. The most important point of all in connection with the transmission and preservation of seeds is dryness without roasting, and a regular temperature at all times. For small packages of seeds, the post is the safest and best means of transmitting them, and canvas bags or paper packets the best of all wrappers. How long a seed will remain good when kept in a seed-room depends on, whether it is oily or starchy, oily seeds perishing in a short time, such being tea, coffee, camellia, theobroma, walnuts, Brazil-nuts, &c. It is, however, impossible to draw a line between long-lived and short-lived seeds, as they are affected by many conditions, perhaps not perceptible to us, or altogether beyond our control. It is not pretended that the Kew method is the best possible, but so far as experience shows a better one has not been devised yet. *I am afraid Mr. Hart's* hermetically sealed packages would only add considerably to the labour and expense of seed packing without making any difference in the preservation of the seeds; on the contrary, we frequently find that seeds thus packed suffer much more than they would do if sent in bags of paper or canvas.—W. WATSON, Kew.—*Proceedings of Agri-Horticultural Society of Madras.*

GIRDLING TREES FOR FRUIT.—The "Fruit Grower," published by Chas. A. Green, of Rochester, N. Y., is commercial in character, hence it finds its way westward by the sack-full. In the last number the following note appears :—

"Professor Budd writes: A Mr. J. B. Spaulding, of Illinois, has practised ringing for fruit for years past. His plan was at first to girdle every other tree, but he now treats all alike. He rings in the latter part of April, taking off a ring of bark from the stem one-half inch in width entirely around the tree, taking care not to injure the cambium layer under the bark. He begins to girdle when the trees are but six years old. So far he has found no harm in the process. The gain is that it sets them to bearing at once, and they bear full, too."

This is followed by a sharp criticism. "Yes," he says, "they bear full. I have seen trees girdled by mice that were loaded with nubbins heavy enough to satisfy the most ravenous grower, but the trees died young. Just how to girdle a tree and not injure the cambium layer is not stated, and seems to be a delicate operation. I am opposed to girdling, and advise all readers not to thus mutilate their trees." All of this, and much more of the same general tenor, is *unfair and intended so to be*. We have never recommended indiscriminate girdling of fruit trees to bring them into bearing, and have never advised girdling in any form for the States east of Lake Michigan. Possibly, at some time. I have used nearly the words quoted in regard to Mr. Spaulding's extended work in girdling trees, but always in connection will be found the advice to confine the operation to such refractory varieties as Yellow Bellflower, Perry Russet, Walbridge, and often the Totofsky, when growing on rich drift prairie soils. We have tens of thousands of Walbridge trees in Inowa of large size to-day *which have never borne a peck of* apples to the tree. Every one of them should be carefully girdled about the middle of next June. If they do not blossom and hold their fruit the succeeding spring, girdle them again in a new place.

If the operation is successful, and in nine cases out of ten it will be, the operator will find that this kind of girdling does not bring the "nubbins" that Mr. Green speaks of in connection with the girdling by rabbits and mice, but it will bring an abundant crop of nice fruit.

That it might shorten the life of the trees to some extent is probable, but the wound soon heals over, and if not repeated too often it does not specially lower the vitality of the tree. At this time Mr. Spaulding's great orchard at Springfield, Illinois, looks quite as well as those of his neighbours which have not been girdled, yet his pockets have been well filled with orchard proceeds when theirs, during the recent trying seasons, have been mainly empty.

Yet we do not recommend girdling such varieties as Duchess, Wealthy, Roman Stem, or farther south, such as Ben Davis, Jonathan, Dominie, Grimes, Golden, or anything else that bears in a respectable way at proper age. But the varieties of apple, pear and cherry, which fail to set fruit on our rich soils,

even when they blossom freely, should be girdled year after year until they come into bearing. To illustrate the mode of doing the work, and its results, the following example is given. A friend pointed out two trees of Tetofsky standing on rich garden soil, of large size, which he said never bore but two apples. We said : "Why don't you girdle them to-day." "I will," he replied, "if you will show me how."

It was then the 10th of June, and of course the bark peels freely. A ring of bark three-quarters of an inch in width was taken off entirely around the stem about one foot above the ground. He said he thought it would kill the trees, but to-day the only trace of the operation is a roughened break in the bark of the stems ; but the whole expression of the tops of the trees was changed. Prior to the operation the trees had a growthy, forest tree expression. Now the annual growth is short and the branches are lined with fruit spurs. The year after the ringing, the trees were loaded with fine fruit, and they have not failed to bear a fair crop since.—*By* PROF. J. L. BUDD.—*Farmers' Review.*

SABE, SABAI, OR BABUI GRASS* (*Andropogon involutus*).—Mr. Clarke, Secretary to the Chamber of Commerce, addressed the Society in reference to Sabai grass, making the following inquiries :—

1. Where the grass is grown ?
2. Whether it can be procured in large quantities ?
3. The purposes for which it is used ?
4. Whether it is exported in quantities ?
5. To what market it is exported ?

A number of members of the Society in different districts were referred to, and answers have been received from Dr. Hill, Purulia ; Mr. H. Dear, Monghyr ; Mr. Gibbon, Bettiah ; Mr. Dalgleish, South Darbhanga ; Mr. Gale, North Darbhanga, and Mr. Slack, Giridhi ; while others are still expected. The letters will be printed in the Journal for future reference. Their substance is embodied in the following reply to Mr. Clarke :—

As I am now in possession of somewhat fuller information regarding the Sabai grass, regarding which you addressed this Society on the 11th instant, I have now the pleasure of replying to you at somewhat greater length. In your letter of inquiry you refer to the grass as being exported largely from Tirhoot, but my inquiries confirm the opinion I ventured to express in my note of the 12th instant, that *Sabé* is not a product of that district, but is imported from the foot of the Nepál Hills. The consumption of the grass in the form of string, varies with the

* Can this grass be the same as the *Bhabar* grass of the Lower Himalayas and Siwaliks (*Pollinia eriopoda*), which is largely used for rope making, and we believe for paper manufacture at Lucknow ? Mr. Duthie could afford the necessary information if supplied with specimens.—[ED.]

distance from the source of supply. It is very little used in the south of Darbhanga District, and very largely used in the northern portion of Chumparun. In the latter district it is grown to some extent on the land bordering on Nepál. Locally the grass is used only for making into string, but last year the grass in the part of the district referred to, was bought up for export, and the whole has this year been secured.

The grass exported from Chumparun last year went directly to the Bally Paper Mills.

In the Monghyr District the grass is grown all over the Kharakpur range of hills, it is exported thence to Patna and other neighbouring markets, and large quantities would be available. The local price is about Re. 1-14 per maund. The only purpose for which it is used is for making into string, and it is sold both as string and in its unmanufactured state.

The grass is grown also on the Rajmahal Hills.

In Chota Nagpur the grass, known there as *Babúi*, is in some parts *cultivated*, it is grown in Manbhúm District, especially in Burrabhúm and Patkúm in Singbhúm, and in the Bhúskar jungle in sub-division Jamtara, Nya Dúmka District; large quantities may be procured; manufactured into string it is sold at Rs. 3-2 to 3-12 per maund, and exported to Bankúra, Raniganj and Calcutta. The raw product, it is said, is not exported, but can be purchased in February to May at from 12 annas to a rupee a maund. The only use to which it is put is in making string.

In none of the districts is the grass used for any purpose but making string for many varied uses.—*Proceedings of Agri.-Horticultural Society of India.*

WOOD SPIRIT, OR PYROXYLIC ACID.—In reply to "S. A. L.," when wood is subjected to destructive distillation, a number of complicated products are formed varying with the nature of the wood and the temperature. If the wood contain azotised principles ammonia will be formed. If the object of distillation be chiefly for the sake of the charcoal, whitewoods are placed in iron retorts, which are gradually heated to redness. The volatile products consist of gases and vapours; among the former are carburetted hydrogen, carbonic acid, carbonic oxide, &c. The vapours condense into liquid or solid products; some of the liquids are soluble in water, such as pyroxylic acid, or wood spirit, pyroligneous acid, &c., and the insoluble products forming tar and certain oily substances. Tomlinson says, wood spirit is an important substance, and resembles alcohol in its affinities, forming an ether and a series of compounds exactly corresponding with those of the vinous spirit. Like alcohol, wood spirit is regarded as a hydrated oxide, of a body corresponding with ethyle, and which like, that body, has not been isolated, it is

called methyle. Wood spirit is contained in the acid liquor or wood vinegar produced by the distillation of wood, and is separated by distillation, the first portions which pass over being set aside. The acid liquor does not probably contain more than 1 per cent. of spirit. A portion of the acid liquor comes over with the spirit, and this is neutralised by means of hydrate of lime, and the clear liquor separated from the oil which floats on the surface. When pure, wood spirit is a thin colourless liquid, with a peculiar odour unlike that of alcohol, and it has a hot, disagreeable taste; it boils at 152 degrees Fahr., its density is ·798 at 60 degrees, and the density of its vapour is 1·12. Wood spirit mixes freely with water, and, like alcohol, dissolves the resins and volatile oils, and is often a cheap substitute for spirits of wine for that purpose. It may also be burnt in a spirit lamp, but it emits a peculiar odour which is apt to produce headache.—*Timber Trades Journal.*

FUNGI ON ROOTS OF TEA BUSHES.—Messrs. Jardine, Skinner and Co. forwarded some roots of tea bushes with the accompanying letter :—

"We send herewith roots of tea bushes that have died off on forest land on the Duars.* The bushes thrive well for a time, then suddenly wither, and it is noticeable that in every, or nearly every, instance the bushes that die are adjacent to decaying stumps of trees felled when the land was cleared of forest. The bushes are from 2 to 3 year old, and as a rule, do well in the soil of the garden.

"Perhaps Dr. King or Mr. Wood-Mason would kindly favor us with their views as to the probable cause of the bushes dying. Can it be fungus from the decaying stumps and roots of the forest trees?"

The roots were sent to Dr. King, who very kindly furnished the following report :—

I have carefully examined the diseased tea bushes sent to me with your letter of 18th instant, and I have submitted them to Dr. D. D. Cunningham who makes vegetable blights a special study. The result of Dr. Cunningham's examination of the specimens is, that the root bark has in them all been completely destroyed by a minute fungus. It is extremely likely that this fungus originated in the dead and decaying stumps which your correspondents say abound in the garden from where the bushes come. But whatever may have been the origin of the blight, it is infectious; and all tea bushes affected by it should be rooted up and carefully burnt. Beyond this precaution I can suggest no remedy.—*Agri. and Horticultural Society of India.*

* This dying off of tea bushes round dead stumps was noticed in Assam in 1874 by undersigned.—[ED.]

TABASHEER.—Mr. Dyer in his article on 'Tabasheer' in "Nature," of February 24th (p. 396), throws out the suggestion that the silica deposited in the joints of bamboo may have undergone a process of dialysis. It may be of some interest to him and to your readers generally, to learn that plates of transparent compact silica ($Si\ O_2$,) may be formed by dialysing the *basic sodica silicate. Four or five years ago I discovered* this, and succeeded in producing plates a quarter of an inch in thickness and 4 inches in diameter, by placing the basic silicate of soda within a dialyser, which was floated on dilute sulphuric acid, 1 part to 20. The plate of silica was formed in the floated vessel. A similar result may be obtained by placing in a wide test-tube a portion of basic silicate. Taking care that the upper portion of the tube is quite free from adhering silicate, the dilute acid should be poured on to the surface of the silicate without disturbing it. After a few hours the silica is eliminated in a *crystalloid form.*

Possibly the first process may help us to understand how tabasheer may have been deposited, while the second may throw some light on the formation of raphides, carbonic or some other acid being the active agent.—THOMAS ROWNEY.—*Nature.*

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A FOREST TOUR IN PROVENCE AND THE CEVENNES.

(*Concluded from page* 256).

One of the great difficulties to be encountered in this region is the forest fires, which sometimes cause incalculable damage. On limestone rock much of the undergrowth is of a nature which tends somewhat to impede the rapid progress of the flames. But here everything is as inflammable as possible, the ground below the shrubs being covered with pine needles and cones, which are full of resin. There is, in many parts of the forest, a dense undergrowth of shrubs, chiefly the arborescent heather, which, rising to a height of 12 to 14 feet, becomes, in the hot season, as dry as tinder, and when fire enters burns with terrific heat, killing off all the pines and such of the oaks as are too old to coppice. The ground then usually becomes covered with an extraordinarily dense crop of pine seedlings, sown from cones on the burnt trees, or from those on the ground which have been opened by the fire without the seed being injured; and these grow up more rapidly than the heather, forming with it an almost impenetrable thicket, in which the oaks, if not freed by clearing round them, become suffocated. It would be impossible to raise a finer crop of pines than that which follows the fire, but unfortunately it is the oak which is wanted, and not the pine. The ready reproduction of the latter species is, however, advantageous, for the associate required for oak is always growing,—there is nothing to be done to raise it; while as it does not coppice, it is always easy to get rid of. But should a second fire pass over the ground before the new crop of pines has seeded, the effect would be very serious, for then replanting must be resorted to.

There are several methods of dealing with the fires. The first and most effectual system is to grub up all the heather and

other shrubs by the roots, so as to leave nothing on the ground that can burn. But this is an expensive process, costing from £3 to £5 an acre; and it has to be repeated, though at a reduced cost, every few years. It is rarely attempted, except by private proprietors, and it could not possibly pay in the case of a crop less remunerative than the cork oak. This process is manifestly open to the grave objection, that the soil, deprived of its protective covering, is deteriorated by exposure to the sun, and washed away by the heavy rains; but the cultivation which it receives during the process of extracting the roots may compensate this disadvantage to some extent. The usual method of guarding against fires is to completely clear broad lines —from 50 to 130 feet wide—of everything but cork oak; the roots of shrubs and coppicing trees being dug out, and all inflammable refuse being thrown into the forest on either side. The fire-lines are traced on the same principle as they are in India, *viz.*, in all cases, round the outside of the forest, and through it when necessary; they follow the crests of ridges and spurs as far as possible. Fire-guards are employed to watch the forest during the four hottest months of the year, there being four of them for the forest of 7,500 acres. These men spend their spare time in making and keeping in order the numerous paths that intersect the forest in all directions; and in case a fire breaks out, they give the alarm to the inhabitants of the neighbouring villages, who are compelled by law to assist in its suppression. This is accomplished principally by means of counter fires, in the management of which the people are very skilful. Proprietors in this region, who have not entirely cleared their forests of inflammable shrubs, are bound by law to maintain cleared fire-lines round them.

There is another method of dealing with fires, which is believed to be peculiar to the Maures and the Esterel. Under this system, locally known as that of *petits feux*, or small fires, the forests are burnt "to save their lives"; or, in other words, in order to secure them against risk of total destruction by the entry of an accidental or incendiary fire, over which it might be impossible to gain control, they are treated to burning in homœopathic doses under the fostering care of their owners and guardians. This practice, which in the lecture-hall at Nancy is characterised as "detestable from all points of view," is carried out by dividing each compartment of the forest into vertical strips, the first of which adjoins a cleared vertical fire-line; each strip is then burnt in succession from the top downwards, the workmen remaining with the fire in order to control its downward march, and to keep it from spreading inwards. The young pines are burnt up with the heather and other shrubs; but from what has been said before, it will be seen that this is not a matter of importance. Every endeavour is, however, made to save the young cork oaks, by keeping the fire from

them, and the larger ones can, generally speaking, be protected. The small ones are burnt, but they coppice well; and by the time it is necessary to burn the forest again, they have attained a size which admits of their being specially cared for when the flames pass round them. The operation must be repeated every six or seven years, or more frequently if necessary, to prevent the undergrowth of shrubs from becoming so dense and tall, that the entry of an accidental fire would be attended with disastrous consequences. Of course there is a certain amount of risk of the fire escaping beyond control, but this does not often happen. Masses of young seedlings could not be treated in this manner; fire-lines must be made round them.

The advantage of this system, as compared with the clearance of the ground by digging out the roots of the shrubs, is its cheapness; it costs only some 3*s.* or 3*s.* 6*d.*, instead of from £3 to £5 an acre. But its disadvantages are obvious, for it injures the stems of the older trees, and burns up the covering of decaying leaves, which, especially in this hot climate, is so much required to protect the soil, and prevent its impoverishment. The only thing that can be said in its favour, in addition to its cheapness, is that the "small fire" is under control, and the extent of the damage it causes can be estimated and taken account of; while by means of it the forest is saved from risk of total destruction, through an accidental or incendiary fire entering it after a great mass of combustible materials has accumulated on the ground. But the existence of this practice cannot be in any way used as an argument in favour of permitting the annual jungle fires to pass through the Indian forests. An essential feature of the Provence system is that there is an interval of six or seven years between two burnings, and that in this interval young trees can grow up and establish themselves; while the fire being kept always under control, the workmen can succeed in protecting from injury by it at least the greater part of the larger plants of valuable species. Annual fires do not fulfil the first of these conditions; while, except perhaps in the deodar forests, where the Provence system could hardly be applied, because the young trees unavoidably burnt will not coppice, there is usually so much coarse grass, and the fire is so intensely hot, that the kind of control above described could rarely if ever be exercised, and all young growth would almost to a certainty be burnt down.

A fourth system of protecting the forests from fire is a modification of that last described. Under it the shrubs are cut down, and either laid on the ground before the fire is lighted, or taken out and burnt separately. This system is sometimes practised when the shrubs, being very tall, would cause the flames to mount high up the stems of the older trees. It has some advantages over the ordinary method of *petits feux*, but costs about four times as much. Where precautions of the

nature above indicated are not taken, or when they prove ineffectual, serious disasters occasionally ensue, areas of 25,000 acres of forest being sometimes consumed by a single conflagration. A portion of the forest we passed through was burnt in 1862, and totally destroyed.

After having spent several hours in studying the many interesting questions to which our attention had been directed in this forest, we drove to Collobrières, where we were to pass the night. While waiting for dinner, we went out to visit a cork factory in the village. The sheets of cork are boiled in order to make them soft and pliable, and they are then piled up under heavy weights to flatten them out. After this they are cut into strips, and these are again divided into a number of short lengths, so as to form little cubes, each of which is destined to be turned by a lathe into a bottle cork, the diameter of which depends on the thickness of the sheet of cork. It is surprising to see how easily the wet cork cuts, but of course the knives are kept very sharp.

Before leaving Collobrières next morning we visited a factory in which the roots of arborescent heather (*Erica arborea*) are prepared for conversion into tobacco pipes, an industry which follows the practice of grubbing up the heather roots in the cork oak forests. This shrub has an underground stem, which, when the part above ground is burnt down, lives and gives vigorous coppice shoots, these being in their turn burnt down, and after a number of years the stem attains very large dimensions, much in the same manner as the sál (*Shorea robusta*) in Northern India. The underground stems or stumps when dug out are, as a rule, converted into charcoal; but a small proportion of them, ordinarily some 4 or 5 per cent., which have sufficiently compact fibre, are selected for pipe-making, and are carried down on the backs of mules to the factory, where they are sawn up into pieces having more or less the shape of a pipe, these being exported to Paris and other places, where they are carved and finished. The wood is liable to split if it is allowed to dry rapidly; and to avoid this the stumps are thrown into water as soon as possible after their extraction from the ground, and the sawn pieces are exported wet. The result is what is known in England as "briar" wood pipe, this name being evidently a corruption of the French word *bruyère* or heather. The stumps of the arbutus (*A. Unedo*) are also used for the same purpose; but they are not so valuable as the heather.

On leaving Collobrières we drove some miles up the cart road, passing many tracts well stocked with Spanish chestnuts, which are grown, partly for the sake of their wood, and partly for their fruit; in the latter case they are always grafted. The forest guard said, that far away on the hill, there was a tree of this species measuring 45 feet in circumference, but we had no opportunity of testing the accuracy of this statement. After

breakfasting at the roadside, we shouldered our knapsacks, and mounted to the top of the ridge, where we saw further examples of the extraordinary vigour with which the cluster pine grows on parts of the forest that have been recently burnt, and can maintain itself above the heather coppice. It seems quite possible that the best way to obtain a crop of deodar or pine in some of the Himalayan forests, where there is a dense matting of needles on the ground, may be to burn them off, taking due precautions to control the fire, and prevent its injuring the stems of the older trees.

After walking for some distance, we ascended the peak of Notre Dame des Anges, from which we obtained a magnificent view over the greater part of the department of Var; St. Baume, Hyerès, Fréjus, and the hills about Toulon being seen in the distance. Below us was a small State forest protected by fire-lines, on which the cork oak only was allowed to grow. Notre Dame des Anges, and another peak of exactly similar height (2,556 feet), are the two highest points of the Maures. After enjoying the view for a short time, and examining the ruined church, we commenced the descent to the railway station of Gonfaron. On the way down we passed through a magnificent forest of Spanish chestnut, which has hitherto been worked on the method known as *furetage*, or selection of coppice-shoots, with a view to its yielding vine-props. We observed one remarkable group of eleven stems, each about 3½ feet in girth, growing on a large circumference. At first we supposed that the chestnut must coppice at a great age, but a closer inspection showed us that the space within the circle of stems was occupied by the stools of several generations of coppice-shoots, the diameter of the ring being increased at each felling. The failure of the vine during the last few years has greatly reduced the demand for props, and the owners are now, in consequence beginning to graft for fruit. The method employed is that known in France as the "whistle-graft," which we were shown how to make. It is made on coppice-shoots of two years, or even of one year old, a small quantity of fruit being obtained the third year afterwards; but the crop very rapidly increases, and is a very profitable one.

After descending for a short distance further, we came upon a small sledge drawn by a horse, and used to drag vine props down to the cart-road. It consisted of two rough side pieces shod with iron, and joined by cross-bars; two upright stakes at each side sufficing, with the aid of cords, to secure the load. We were fairly astonished at the performances achieved with this simple apparatus. The road or path was steep, and zigzagged, and had such an uneven surface that we should have thought it impossible to get the sledge down without upsetting it. But the horse, who seemed to know his business thoroughly, started off at a brisk pace, cleverly negotiating the sharp turns; while

the driver, who walked behind, holding a cord which was attached to the sledge, put on the drag, pulling sideways when necessary, in order to counterbalance the numerous inequalities in the surface of the road, and the sledge went swinging down the track, on what seemed to us its dangerous course, but we saw it landed on the cart-road without accident. It would have been easy to make a good road ; but apparently the present one serves its purpose sufficiently well, though the sledge must sometimes be tilted over at an angle of 40°. Such a machine as this might easily be used in India, being dragged by a mule or by men.

On reaching Gonfaron we took the train for Fréjus, the railway passing through a fertile plain, where we first saw the stone pine (*P. pinea*), with its remarkable, brush-like, densely shading crown. Here we were met by MM. Tassy and Muterse, the Inspector and Assistant-Inspector in charge of the Esterel, the latter of whom hospitably entertained some of the party at dinner. Fréjus is remarkable, among other things, for its nightingales, a number of whom sang throughout the evening close to the house ; but their melody would have been more enjoyable if it had not been for a company of bull frogs, who added their deep discordant base to the chorus.

The Esterel.—On the last day of April we made an early start to visit the State forests of the Esterel. We drove past the old Roman ruins for which Fréjus is celebrated ; and crossing the plain, where we saw the Aleppo, cluster, and stone pines all growing together, ascended for some distance by the excellent forest carriage road. We then called a halt, while M. Muterse explained his method of protection against fire. This consists in a system of fire-lines for the younger, and of *petits feux* for the older parts of the forests. There are fire-lines on the crests of all main ridges and spurs, and along both sides of all roads, intermediate lines being cut where they are considered necessary. The forest guards' houses, which are built on points favourable for observation, are connected by telephone with the central house where the *garde général* lives ; so that, on a fire breaking out, the alarm can at once be communicated to every part of the forest, and the whole of the guards and work-people can be assembled at any point in a very short time. Sheds with brooms and tools, required to aid in extinguishing fires, are established at intervals throughout the forest, so that no delay may occur through having to fetch them from a central point. If a fire occurs, it can generally be got under control in this manner ; but if, unfortunately, it has spread much before the men get to it, there is nothing to be done but to light counter fires, which is a very difficult operation if they are required to burn up wind. The arrangements made by M. Muterse are admirable in every way, and might well serve as a model of how such things should be done in India. Until we came to the Maures and Esterel, we had no idea that forest fires were such a serious question in any

part of France, or that such complete arrangements existed for their suppression. The system of *petits feux* is the same as that previously explained; but it may be here added that the law provides that the Prefect shall fix a period in each year during which the lighting or carrying of fire within or near the forests is prohibited; here the period is that from June to September inclusive. The "small fires" must not be lighted during those months, and there must be fire-lines of a fixed minimum breadth, cleared of all pines and brushwood, round every forest so treated. In case of the fire spreading from one property to another during the progress of these operations, or otherwise, the owner of the forest into which the fire has spread can, in case of proved carelessness or non-compliance with the regulations, claim damages against the proprietor of that in which it originated; and on this account the burning is conducted with great care, the ground being watched for fully thirty hours afterwards, in order to make sure that pieces of smouldering wood do not cause the fire to break out again.

The forest is stocked with cork oak mixed with cluster pine, the latter being, as was noticed in the Maures, in too large a proportion; and the efforts of the local forest officers are now directed to the establishment of a mixture such as will tend to promote the greatest possible yield of cork, which is, or at any rate will be, the paying crop. There is self-sown cluster pine everywhere, the seed, which has a large wing, being blown to long distances; and after the ground has been burnt over, a dense crop of pine seedlings comes up, with oak coppice mixed among it in a greater or less proportion. The pines are then cut back, so as to allow the young oaks to grow; and forests of the latter species, mixed with a due proportion of pine, are now being raised in this manner; but in some parts of the area there are no oaks, the ground being entirely occupied by pine poles. We were told that the intention is to plant oaks in such places a few years before clean felling the pines; after which a crop of self-sown seedling pines will be obtained, and the required mixture of species will be thus constituted. Sixty acres of oak were planted last year. At present there is no fixed yield either of cork or of pine wood. As regards the quantity of cork to be removed, it is said that the most important consideration is to avoid over-working the trees, as this diminishes their power of production; but there are no hard-and-fast rules as to the proportion of cork that can be taken from a tree. M. Capgrand-Motte's method of protective envelopes has been tried, but resulted in 95 per cent. of failures, a fungus growth having attacked the matrix. The pines are felled at a minimum girth of 3½ feet; they are barked, cut into 7 feet lengths, and carted out for export by rail to Marseilles to be used for packing cases. It would not pay to allow the trees to grow larger, because the timber they yield would never be suitable for building; and,

while sufficiently large planks of sapwood and heartwood together can be obtained from them at that girth, the growth of the tree is thereafter relatively much slower than before.

The all-round gross revenue of this forest at present does not exceed 2*s.* 6*d.* per acre; but it will, no doubt, be very much larger a few years hence, when the cork oaks, which are now generally speaking young, have had time to grow up. The roads and buildings are extremely well laid out and constructed, each guard's house having a well-kept piece of garden attached to it. Near the *garde général's* house, where we breakfasted, we saw some Australian *Eucalypti* growing, and also our old Indian friend the loquat (*Photinia japonica*). From the ridge near the house we had a magnificent view towards the north-west; but we were unfortunately prevented by heavy rain from attempting to ascend the neighbouring high peak, which we should have very much liked to do. After breakfast, and a conversation by means of the telephone with some of the guards in distant parts of the forest, we drove by another road to St. Raphael, where we saw many gum trees in flower, and also a clump of bamboos, not unlike the small species (*Arundinaria falcata*) which grows on the Siwalik Hills to the south of Dehra Dún. We passed the night at Nice; and after a day spent in well-earned repose, which included a visit to the bank in order to replenish the purse, and to the Conservator to pay our respects, we took train to Nismes, a journey of some fourteen hours by rail, where we spent Sunday morning, reaching Alais, at the foot of the Cevennes, during the evening.

The Cevennes.—The forest of Grande Comble, near La Lavade, was next day visited. It is 5,000 acres in extent, and is maintained in order to supply props for a neighbouring coal mine. It was formed in 1840 and subsequent years, by grubbing up the shrubs, chiefly heather, burning them as they lay, and sowing cluster pine seed broadcast on their ashes. When the trees had reached the age of thirty years, the crop was clean-felled; and the ground then became covered with self-sown seedlings, but seed was scattered where it was thought that their number was insufficient. The trees are now, therefore, about fifteen years old, and they are cut when they have attained a girth of from 15 inches to 3 feet, which is the size of which mine-props are required to be. Formerly the lower branches of the pines used to be pruned off in order to reduce the amount of combustible material near the ground; but this practice has been abandoned, as it was found to interfere with the development of the trees; and there is not much risk of fire, against which other precautions are taken. A plaster model of the forest was exhibited, and the coal mine was also inspected, after which the party travelled by train to Genolhac, higher up the valley. This was the first railway made in France, and it is still the only line of traffic, for there are no cart roads. It was constructed for the

export of produce from the iron, coal, and sulphur mines, of which there are here a considerable number. We were told that mine-props are brought by train from the Landes, and sold at Alais at the extraordinary low price of 3½*d.* per running metre. It is difficult to understand how it can pay to bring them so far for sale at such a price. The railway to Genolhac winds through the Cevennes mountains, and rises very rapidly, the scene reminding us of parts of the Himalaya, and the stream-bed filled with silt telling its own tale of the denudation of the hills through which it runs. There are terraced fields, with chestnut and other fruit trees growing on the steep ground between them, which is supported in places by small, rough dry-stone retaining walls; but, except in one or two places near Genolhac, there are no forests to be seen.

The 5th of May was the last day of our tour. We rose early, and accompanied by M. Dhombres, the Conservator, and MM. Fabre and L'Abbé, the Inspector and Sub-Inspector, commenced the ascent of Mont Lozère, to visit the afforestation works going on there. Four ponies were brought for the elders of the party. They were about fourteen hands high, framed like little cart-horses, and were models of what a hill pony ought to be. One felt that one's weight was a mere trifle to them, and they were as sure-footed as mules.

Regarding the climate of these mountains generally, it may be said that there is little or no rain from February to September, the heat and drought during the height of summer being very great, and the temperature rising to 104° Fahrenheit. Then, in September, there are hurricanes of wind, followed by deluges of rain, the average annual fall being 80 inches. These storms are said to be caused by the meeting of moisture-charged air currents from the ocean and the Mediterranean; they burst with great violence, occasionally as much as 18 inches of rain falling within a single period of twenty-four hours.* Such a flood as this washes down the hillsides, and the streams rise with incredible rapidity, causing great loss of life and property. If it be added that large droves of sheep are annually brought up from the hot southern plain to graze in these hills, it will not be hard to understand that overcutting of the forests, which once clothed the mountain slopes, has led to their almost complete disappearance; and it is on this account that the works we were about to visit have been undertaken. That the forests remained as long as they did, is probably due to the fortunate circumstance that the people about this region do not keep goats. With this latter exception, the conditions resemble very closely those met with in many parts of India, and the visit was a particularly instructive one to us on that account.

* It is said that in 1866, 18 inches of rain fell at Bleymard in twenty-four hours, the total fall during three successive days being 24 inches.

It is said that the works have already had an influence in reducing the amount of silt carried down by the rivers, and in improving the water supply in the hills. Before 1860, when they were commenced, there were very few trees left, the soil being shallow and almost entirely deprived of vegetable mould. The cluster pine was at first sown broadcast up to an altitude of 1,800 feet, which is the limit of its growth as a good-sized tree in this locality. The seedlings grew well for a time, but they met with a severe check in consequence of a series of cold winters, and lately a mixture has been introduced by planting Spanish chestnuts.

The path from Genolhac to the summit of Mont Lozère is 8 miles long and 7 feet wide, having an uniform gradient of 7 in a hundred. It cost £200 a mile. After following this path for some distance, we crossed a torrent, which a few years ago threatened to do much damage. It is not sufficient in a case of this sort merely to sow seeds on the ground ; for success is impossible unless the slipping and falling away of the soil is first arrested. In 1875 dry-stone walls were therefore built across the bed, the loose soil near the head of the ravine being retained in its place by smaller walls, and by fascines picketed down, with young trees planted behind them. Acacia and alder were also planted behind the larger works, and they have succeeded admirably ; but unfortunately a portion of the head of the torrent is situated in private property, and on this account it has not yet been taken in hand. A slope was pointed out to us on the opposite side of the valley, where the loose surface had been fixed by planting broom in lines.

On rising to a height of 2,300 feet, we found ourselves above the limit of the cluster pine, which here had a very stunted appearance. The ground had been sown with *Pinus montana*, mixed with a few Scotch pines, *Laricio des Cevennes* and Austrian pine, which would be properly located on limestone not on granite, and with oak (*Q. sessiliflora*), the acorns of the latter being deep-sown, in order to protect them from frost and rats. We had been passing through a private estate ; and as we entered the Government forest we were struck with its much better condition, due to the needful thinnings having been made among the pines, which do not thrive when grown in dense masses ; they had been too long neglected in the private forests, and the young trees had suffered much from this cause. Here the seed from which the wings had been broken off was sown broadcast during the winter ; and having been protected from extreme cold by the snow, it came up in the spring. We saw a small nursery of Austrian pines, which are to be used lower down, and some plantations of Scotch pine, larch, and birch. The plants are not put out in lines, but are inserted wherever sufficient soil can be found for them ; in some places oak had been sown in patches and pine broadcast. At an altitude of about 4,000 feet,

we entered a natural beech forest, which, before protection was commenced, had been ruined by pasture and over-cutting; when we were there, however, it was throwing up some good coppice-shoots, and will some day again be valuable. Higher up, on an exposed but gentle slope, we came upon a plantation of beech and silver fir (both species of heavy cover) made in open ground without any shelter. This is an experiment only, and its success is not certain; but the sowings have been managed in a very ingenious manner, and it seems quite possible that, in the moist atmosphere at this altitude, they will be successful. Holes 2 feet by 1 foot, and 2 feet deep, were dug, and then half-filled with loose earth, a shelter being made on the south-west side by building up the turf with some stones in the form of a little roughly made wall. The seeds were sown in this corner of the hole, and the young plants grow up under shelter of its sides, and of the little wall at the surface, until they are five years old. At this time the tops are appearing outside the holes, and are somewhat exposed to the sun; but as the roots are far down, in, comparatively speaking, moist soil, and as the stems are also protected by the sides of the hole, the seedlings do not suffer much from the want of overhead shade. But this locality is subject to a most bitterly cold north wind, which blows with terrific force over the open ground; and, in order to protect the tops of the young plants from its influence, the stone and turf walls are, at this stage, shifted round to the north sides of the holes. The young trees thus treated are now making good progress. This system might advantageously be tried for sowing deodar on exposed slopes in the Himalaya. The soil on Mont Lozère is so friable and loose that, even close to the crest of the hill, where the slope is very gentle, there are signs of the formation of ravines, and it has been necessary to erect some stone walls in order to arrest their progress.

We breakfasted in the forest house at an altitude of 4,500 feet, where the snow was still lying on the ground in patches. The house is built in the form of a round tower, with very thick walls, in order to resist the force of the wind; from its windows we obtained a magnificent view across the valley of the Rhone to the Alps near Grenoble, the snow-capped Mont Ventoux standing out in the foreground.

After breakfast we visited a beech nursery. The seedlings are protected from the sun by straw screens during the first year, but are completely exposed during the second and third years; they are pricked out a year afterwards, and planted at the age of five years. We then ascended to the summit, where planting work was going on, at an altitude of 5,000 feet, in the peaty soil just below it. There is no doubt whatever that in former years this mountain was covered with large silver firs; their stumps are still found buried in the peat, and there are large beams of the wood in some of the houses. The disappear-

ance of this tree is to be accounted for by over-felling, which led gradually to the establishment of a pure beech forest, while uncontrolled grazing completed the extermination of the fir. It is now desired to re-introduce a mixture of the two species. When we were there the beech were being put out, the plants being carried up in baskets from the nursery near the house; the fir will be introduced subsequently. The holes are dug by a gang of men working with a very handy implement, something like a mattock, one blade of which is a pick and the other a turf-cutter. The men are followed by women, who put in the seedlings, which are very deeply planted, the earth covering a considerable portion of the stem, in order to protect it from exposure; little walls of turf and stones, similar to those previously described, being made to protect the plants from the wind. A previous attempt to plant *Pinus montana* on this ground failed entirely. On our way back to Genolhac we saw a place where the broom was being cut down in horizontal bands, in order to admit of the ground being planted up. We also observed another locality, at an altitude of 2,000 feet, where the cluster pine, aged from fifteen to twenty years, was either dead or dying from want of protection against wind, and *P. Laricio* was being planted to replace it. On the opposite side of the valley, however, it was growing well at the same level, under the protection of a spur; cedar being mixed with the pine in the proportion of one to three. The cluster pine must have shelter from cold winds, or it does not flourish at all. On nearing Genolhac, a factory was pointed out to us in which a silk-dye is extracted from the wood of the Spanish chestnut.

Next day we commenced our return journey, the line of railway passing through the volcanic region of the department of Ardeche, and entering the valley of the Rhone at Teil, whence we passed northwards by way of Lyons and Dijon to Nancy.

ELEPHANT CATCHING IN N.-W. PROVINCES.

AFTER a lapse of two years, I again take up my pen to chronicle the doings of the Balrampur Khedda under the auspices of Sir Alfred Lyall.

It is needless to repeat the details about catching and taming the wild elephants, as these must be fresh in the memory of most of your readers. Suffice it to say, that the actors are the same as before, Captain Lachman Singh is in command of the Khedda elephants; Sultán Khán, Nunnay Khán and Sálig are his Lieutenants. The mighty Chand Múrut, mightier than ever, is again the warrior of the party, backed up by Raj Ishri Pershad, Jogendra Gáj, Ráj Mangal and fifty others of lesser note. Mangal Gáj, second to Chand Múrut only, had to be left behind, as he had turned very vicious and killed his mahout a few days before the start was made.

The Khedda party left Balrámpur in November, and commenced operations in the end of December, between that time and the end of January they had captured twenty-seven elephants.

His Honor the Lieut.-Governor and party joined the Khedda camp on the 1st February. On the way up the sportsmen with the camp, under the able leadership of Mr. Markham, bagged two tigers, two leopards and a goodly quantity of smaller game. One of the tigers fell to the rifle of a guest, Lord Stradbrook, another guest, Lord Dungarven, had a shot at a tiger, but failed to bring it down.

The Khedda camp was pitched in a very picturesque spot inside the hills, where the Sona stream runs into the Rámganga. The approach from the plains is through a defile cut by the Rámganga in the outer ranges. The road is carried along the side of steep cliffs and precipices. A camel of Mr. Markham's, laden with good things, fell over one of the latter, and was dashed to pieces. The scenery is very beautiful, in some places grand. The river below is as clear as crystal, huge mahsír could be seen lying motionless at the bottom of the pools, and at this time of year, they defy the skill of the ablest angler: every hundred yards, or so, there is a cascade, or a rapid; in the sandy bays, numerous aligators were observed basking in the sun. The hills, where the slope admits of it, are well covered by trees of all sorts, sál predominating. After advancing five or six miles from the plains the scenery quite changes, the bluff precipitous mountains and roaring torrent give way to a peaceful valley surrounded by low-lying hills, the river passing on quietly and noiselessly as if anxious not to disturb the stillness that reigns around. This beautiful valley, called the Patli Dún, far away from the haunts of men, is left in the sole possession of wild elephants, tigers, and other denizens of the forest. The whole Dún, about thirty miles long, and from watershed to watershed fourteen broad, is reserved Government forest, and is full of good timber of all sorts and ages. As civilization presses on and railway communication is extended, this valley will become a most valuable property, worth many lakhs of rupees to Government. On the way up, in what seemed a perfectly inaccessible place, marks showed where a herd of about fifteen wild elephants had crossed the road during the night, some of them had slid down almost sheer precipices of 40 and 40 feet.

On the arrival of His Honor, the Khedda elephants were paraded for his inspection, all except Chand Múrut, he was in an unusually unsociable, not to say vicious and dangerous, humour; so it was thought advisable to leave him alone, lest he might interfere with the harmony of the proceedings. After the parade was over Chand Múrut was honored with a special visit, not only was he secured like a man of war with many moorings fore and aft, but his fore legs were firmly lashed together by a

very thick rope passed round and round each leg for about 2 feet above the ankle. The hind legs were tied in a similar manner.

Having duly admired the grand proportions of Chand Múrut, the party proceeded to examine the newly captured elephants. Captain Lachman Singh pointed out the good points of the various captives, and they certainly seemed a very fine lot. It was curious to observe the different behaviour of different animals under the same circumstances; some seemed quite resigned to their fate, stood peaceably in their places eating their food with perfect indifference, others still fought against their lot, and struggled hither and thither digging deep holes by kicking out the earth and stones below them. Others again made frantic rushes at any one who approached them, or seized sticks stones, or anything handy in their trunks and dashed them at the intruder; some neither fought nor struggled, but refusing to eat or drink remained either sullen and sulky, or broken hearted, brooding over their hard lot. It was very sad to watch some of these last, their freedom gone, tore away from their favourite haunts to be beaten and bullied by heartless mahouts. I forgot to note that though nearly everything is the same as on former occasions, there is a new leader, Captain Anson, who has taken the place of Mr. Greig, and most ably has he managed everything.

His Honor took advantage of the halt on the 2nd, to examine some of the forests, and in conjunction with the Forest and Revenue officers, to settle some vexed questions of forest rights and forest expenditure.

On the evening of the 2nd Captain Anson passed orders for a move next day.

The Khedda elephants were to start very early in the morning, and advance nine miles up the valley; the spectators were to start later, have breakfast at the rendezvous at nine, and thus all were to proceed to a glen five miles off, in which a herd of twenty elephants had been marked down. Everything was carried out according to orders, the captured elephants were all left behind, carefully tethered to trees, four medium-sized tuskers were detailed for the duty of looking after them, and calling them to order should any of them become obstreperous.

At ten o'clock, the line of Khedda elephants were seen coming along, all girded up for action. Chand Múrut brought up the rear, some distance intervening between him and the rear of the line, but as he appeared in a very dangerous and aggressive mood, it was thought wise to send him back. Most people experienced a feeling of relief when they saw his bulky form slowly wheel round and move leisurely home again; some of those present who, twelve years ago, had seen Chand Múrut venting his displeasure on his friends, by bowling them down on all sides, knew well that he was the most dangerous brute in the valley that day.

The direction taken was straight across the valley, on the western side of which the herd was known to be in some low hills.

Great was the disgust at learning, on reaching the spot, that the wandering herd already alluded to had crossed over from the east during the night, joined the stationary herd, and taken all away to the west.

Trackers had followed after them, and it was determined to make a detour with the line and push on, in hopes of being able to cut off the retreat. This was indeed disheartening, in the morning everything seemed so certain, a failure was not thought of, now, it was exactly the reverse, with the wandering herd leading the way, it was impossible to say when, or where the elephants might stop.

However, there was no help for it, all that could be done was to make the best of it and push on at once.

The scout who had remained to show the way took a route due west at right angles to the hills, which as a rule ran north and south. For miles and miles the line toiled up one hill, down the other side, up another hill, down again, and so on. The Captain's face grew longer and longer, and there was a general feeling of despair. It seemed a hopeless business to come up with the wild elephants, and still more hopeless to have the slightest chance of catching them in the network of hills into which the line had penetrated. Neither the Captain nor any of his subordinates knew the ground, it was a strange country to them, there was not a sign of any break on the hills, the scout alone kept up his spirits; he vowed there was a capital place on ahead and that the elephants were almost certain to halt in it. His confidence inspired new hopes, but after wandering on for some hours, and still no break presenting itself, it was unanimously agreed that it would be better to return to camp and try some where else next day. The old Captain alone supported the scout, and urged a further advance; Captain Anson also was in favour of pushing on. A halt was called, and the matter was being discussed when up rushed a tracker breathless from running, and incoherent with excitement he gasped out "push on, push on, as hard as you can, the elephants are in a splendid place, and if you can get there in time you will be sure to catch a number."

This was glorious news, and all pressed on at once with renewed energy and hopes. Captain Anson and Lachman Singh went ahead on foot to arrange the plan of action, and the others followed on elephants as quickly as possible. Very shortly Captain Anson was met returning. He explained that the elephants were in a valley a few hundred yards in front, that the footmen had been sent to man the heights round the valley, that the Khedda elephants would be divided into two lots, one to drive down the game and the other to meet them. The danger was they might break west, but every precaution was being taken to prevent

this. The hills overlooking the valley were soon reached, and it was at once seen that the latter was most admirably suited for the purpose. The valley was far in in the interior, surrounded on all sides by successive ranges of hills. It was about a mile and-a-half long by less than half a mile broad, crescent shaped. It was covered by high grass, a small stream running down the centre and hardly a tree in it. At the north-west end precipitous high hills effectually barred the way. On the east side the ground was, as a rule, steep, and could be easily guarded by footmen. There remained the way the elephants had come in from the north, the western and southern sides to protect. Fifteen elephants and a number of footmen, armed with muskets, were sent round to the west. Half way down on the west, five more elephants were placed, and about three-fourths of the way down towards the south, six elephants were ranged on either side. Footmen being posted in small bodies all the way down. The remaining elephants were divided into two lots, one was to move up through the forest and come in by the northern entrance, the way the wild elephants had taken, and the other was to line the eastern side ready to rush out when the elephants were driven down. Footmen lined all the heights on the east. The spectators were divided half between the two last lots, and half were sent to a knoll covered with trees, from which the whole valley could be seen. With the exception of the valley itself all the rest of the country was densely wooded, so it was easy to move about without being seen. On reaching the knoll and peering through the trees the wild elephants could be seen about half a mile off, huddled together evidently suspicious that something was up, but not knowing exactly what. There were about thirty or forty altogether. They were not the jet black that wild elephants usually are, but a curious metallic grey. This was from the nature of the soil on the hills they had come through, there being a great deal of mica in it, and the elephants after bathing in the muddy pools or showering water over themselves were soon coated over with a layer of the very finely powdered mica and sand. As the Khedda elephants moved in from the north, the wild ones could hear but not see them, and taking alarm they broke into two herds, the smaller went west into the sál forest, and the other advanced well into the valley. As they did this the line of Khedda party on the east rushed out, the wild elephants turned and fled uphill again, but seeing more Khedda elephants coming down from the north they halted, remained undecided for a few seconds, and then came back with the intention of breaking through the line. They had rather the best position, as they were slightly uphill, but there were no very large and heavy ones amongst them. The Khedda mahouts saw this, and so advanced boldly. The wild herd came down with a determined rush, but they had not sufficient weight. They were met with

yells and shouts, and although they pressed well on and bore down some of the Khedda elephants, they could not get through the line. The northern lot of the Khedda coming up at that moment, the discomfiture of the wild ones was rendered complete. Wild and tame elephants were now mixed up in a mingled mass swaying here and there, the mahouts shouting, the elephants screaming, the footmen on the hills firing. Never had the peace of that valley been disturbed in such a ruthless manner before. During the *mêlée* eight nooses had been successfully thrown, but the captured, their capturers, stray wild elephants and pursuing Khedda elephants were all so entangled together, it was impossible to tell what had been done, leaving the captured to fight it out as best they could, the rest of the herd dispersed and rushed down the valley in twos and threes hotly pursued.

In the meantime, the small herd had not fared much better. They had tried to break west, but being met with steady volleys from the footmen had to turn, and dashed down south, closely followed by Nunnay Khán's party. At first, it could not be seen what was happening, only the shouts of the men and roaring of the elephants could be heard, accompanied by volleys from the soldiers: the sál trees could be seen waving about, and every now and then one smashed down, but no elephant could be seen. At last they broke on to the valley and mingled with the others. It was a grand sight to see the whole valley full of wild and Khedda elephants, pursued and pursuers rushing here, there and everywhere.

It was too much for the spectators on the knoll, and headed by the Lieut.-Governor, down they rushed to join in the fray. The advent of these newcomers caused a temporary check, and many of the wild ones dashed back through their pursuers. The herd was now completely broken up, and it was a case of every one for himself, the mothers alone stuck faithfully to their young ones, and did their best to save and protect them.

The Khedda elephants were all scattered about in small batches pursuing the dispersed wild elephants in different directions, the spectators joined in, some here and some there, and rendered great assistance by cutting off and checking retreating elephants. In fact had it not been for the help rendered by the spectators, many wild elephants would have escaped. It is quite impossible to recount all the incidents of the day over such a scattered field, we can but note a few of them.

Two wild elephants were being pursued by three Khedda elephants and three or four spectators. The Lieut.-Governor seeing the wild ones were heading for a certain point, pressed on to cut them off, going at full speed. Suddenly elephant and all disappeared into a deep hole. It seemed for some seconds as if the N.-W. Provinces had lost its ruler, but old "Deedar Bakhsh" picked himself up, and was soon seen struggling up,

His Honor sticking on tight. The wild elephants were turned, surrounded and noosed.

Mr. M. and Lord C., in company with two Kheddas, were chasing a fine young makna. He dashed up a hill, M.'s elephant after him. He was met at the top by a volley from the footmen, and came down with a rush, sending M.'s elephant flying; M. being in front and having nothing to hold on, was thrown on to the ground. His elephant bolted, Lord C. holding on like grim death. In the high grass it was impossible to see anything, but hearing an elephant approaching M. rushed off in the opposite direction. Another was heard coming from there. Again he ran, but hearing them on three sides, he thought it useless to run any more, and determined like a true Scot to face his enemy boldly and meet his death bravely. Although somewhat trying for M., it was most amusing to those who had seen what had happened—in the confusion occasioned by the collision the wild elephants rushed off unseen by the Khedda mahouts. Those who saw the grass waving when M. ran off dashed after him, three circled round him, and made sure they had their prey quite safe. They approached steadily, the mahouts with nooses up-lifted all ready to lasso the wild elephant. All was still. Says one mahout, "ho brother, where is the elephant, I can see nothing of him:" the second mahout replied, "God knows," and the third said, "it must be a very little one." In the meantime M.'s mahout had turned his elephant, and seeing what had happened rushed back yelling out "hathi nahin hai!" "hathi nahin hai! Sikatar Sahib hai!" the discomfitted Khedda mahouts had to retire amidst the laughter and jeers of their fellows, and thus was the private secretary rescued from the jaws of death.

Dr. L. and Mr. C. under similar circumstances fared better. A wild elephant rushed straight down-hill at them, their mahout endeavoured to keep his elephant "Moti Mahal" head on, but not a bit of it. Just as the wild elephant was on her, she suddenly wheeled round and met the charge, if not gracefully, certainly most effectively, and no one was hurt. No doubt she knew best where her strength lay.

Heera Bahadur's mahout had noosed a makna at the same time as Sultan noosed a fine young female. She dashed forward, then turned suddenly round, and came rushing back with Heera Bahadur between her and Sultan. The rope was strained perfectly tight, and passing over Heera Bahadur, swept off both his mahout and driver. Away he bolted with the young makna, and for a long time they could be seen rushing about wildly. Every now and then discipline seemed to get the better of Heera, and knowing his work well, he would pull up and check the makna, but after keeping him in check for a little, and seeing no mahout, he would again give in. Make up his mind to try and gain his freedom and roam about the forest at will with his

young charge. It was not until quite towards the end of the day that his mahout managed to get near him on another elephant, and from it jumped on his back. He was then perfectly quiet and obedient. When all the big elephants were fast on to wild ones, a large makna that had been in hiding in some extra high grass was disturbed by two medium sized Khedda elephants; off he bolted, the others after him. He came dashing down where H. H. was, but seeing "Deedar Bakhsh" he halted, turned round, and met one of his pursuers, sending him flying. He then made for the other, and would have knocked him down too, but H. H. spurring on Deedar Bakhsh charged the makna, and catching him on his side rolled him over. As he got up Deedar Bakhsh again attacked him, and before he could recover himself the Khedda elephants had him fairly noosed. This was the largest elephant caught that day, and we hear that the Maharani of Balrampur has asked Sir Alfred Lyall to select an appropriate name for him in honor of the event.

L. and P. were on an elephant together. But either the elephant was slow, or the mahout was faint-hearted, do what they would, they could not get on to terms with the wild ones. Offers of bakshish and threats of assault were equally useless, their elephant was always twenty or thirty yards behind. At last they were clean distanced and left alone, when to the horror of the mahout he saw a wild elephant coming down on him from the right; he turned to bolt to the left, but saw another approaching from there. He stood still paralyzed with fear, it seemed all up with poor L. and P.

L. was regretting that he had taken so much trouble about banting for the past few months, and let many good things of this life go by unheeded, when it was all to pass away so soon. P. rather wished he had not left his hunting box in Leicestershire; but they made ready to defend themselves to the last, the former armed with a neat cane lately brought out from London, and the latter with a hunting crop. On came the wild ones, but when the fate of Kishen Pyari seemed sealed, they suddenly wheeled round and retreated with shrill screams. Various reasons were given for their extraordinary conduct. Some thought that they were under the impression that Kishen Pyari was a friend, and did not discover their mistake until close up. But our opinion is, that on one side the latest thing in combined knicker-bocker riding breeches and gaiters, and on the other side the newest scarf and pin suddenly broke upon the sight of these poor innocents of the forest, and so utterly astonished them that they could do nought else but turn tail and flee.

These are but a few of the incidents of the day; one fine young makna fought out to the very last. He doubled back here and rushed there, backwards and forwards, up-hill, down-hill, and it seemed as if he would never be caught. At last the Lieut.-

Governor on Deedar Bakhsh headed him, and kept him at bay until he was noosed. There being no more elephants in sight, the spare elephants were sent off to help those that had noosed wild ones, high up in the valley, and had not been able to bring them down, on the contrary were themselves being dragged about all over the place.

When all were assembled it was found that twenty-one elephants had been captured, many of them being fine specimens. The big makna had been behaving very quietly all this time, but when the homeward move was made, and it came to his turn to go he would not budge. He tore about here and there, and every second it seemed as if he would escape. Captain Anson accordingly ordered the release of a large old female who had two big tuskers guarding her. The two tuskers, aided by the three elephants with the makna, soon brought him to reason, and he moved off. But curious to relate the released female would not go, and followed for a long way. It was tedious work slowly climbing hill after hill, at the same time it was wonderful to watch the great unwieldy brutes picking their way over pathways which seemed fit only for goorul. Most of the spectators got off and walked down the hill. The Lieut.-Governor and Mr. Woodburn were leading, when suddenly they came face to face with a wild elephant who barred the way. They retreated up-hill, and the whole party getting on to their elephants advanced again and the wild one fled. It was very late at night before the Khedda elephants and their prizes reached camp. It was impossible to tie up the wild ones, so the poor mahouts had to stay the whole night on their elephants ; luckily Captain Anson had a goodly stock of rum, which was freely served out and kept the men from perishing by the intense cold.

The day's operation was most successful and most enjoyable. Nothing could have been better. No theatrical manager could have arranged a more perfect spectacle for his audience, all who were present will, for many a long day, look back with the greatest pleasure to the elephant hunt in the Patli Dún. We are only sorry that our description of the chase is so feeble.

H. G. R.

FOREST FIRE NEAR MURREE.*

THE Forest Department method of conservancy has resulted near Murree, *twice* in ten years, in the destruction of thousands of beautiful trees in a few days. The yearly fires never did that. The fact that the forest fires that were lit yearly in these

* The above correspondence, which appeared lately in the "Pioneer," is reproduced for the benefit our readers, with a further Note by Mr. Hearle, on the splendid results of fire conservancy as regards the natural reproduction of kail.—[ED.]

forests did not destroy the forests when there was no attempt at preservation *proves* that all seedlings could not have been destroyed: proves that *very many* seedlings were not destroyed. But I meant that gaps should be filled by seedlings from nurseries. *Rain falls daily for several months in each year: yet when* we say "*after the rains,*" no one would assert that we meant after every fall of rain. There is a time in each year when the last needles of the past year have fallen and nothing but the new growth remains on the trees. This is the time chosen by the villagers to destroy the fallen leaves, chiefly for the purpose of allowing the grass to grow for their cattle—lean at all times, and probably destined to be thinned away altogether under forest conservation rules. If fires could be prevented the present system would answer; but, as that cannot be done, it behoves our rulers to try some other method.

S.

I was surprised to see a letter from "S." in your issue of yesterday (24th ultimo) declaiming against the fire-protection of pine forests. "S." apparently thinks that Forest officers pay *more attention to theory* than to fact, and that, although they devote the whole of their energies to forest conservancy, they have not yet been able to discover the important fact that it is safer to burn pine needles yearly than to attempt the protection of the forests. One swallow does not make a summer: neither does one disastrous fire prove the fallacy of fire-protection. Terrible fires in pine forests are common in countries where regular protection has never been attempted: notably in America, where a year or two ago the capital of British Columbia was half destroyed by a fire carried from the adjacent forest by a high wind.

I am not acquainted with Murree, but, having had some experience amongst similar forests in Jaunsar, I venture to make a few remarks on a subject in which I take a great interest. The blue pine (*Pinus excelsa*) is of all Himalayan trees the one most susceptible to fire, and in Jaunsar it occupies the zone of vegetation in immediate proximity to the villages. When these forests were demarcated and fire protection first started in 1872, their state (I am talking of the blue pine forests, some of the fir forests being magnificent), was deplorable in the extreme. Open grassy hill-sides, where all the pines had been burnt out, were to be met with everywhere, whilst on some slopes there were still the remains of what had once been a pine forest, but now containing scattered old trees of blue pine and deodar, many of them half burnt through. In certain damp localities only, where fires did not occur every year, could the stock be really called a forest. What then has been the result of their protection from fire during the past fifteen years? The greater portion of the previously bare slopes are covered with a magnificent

young growth of the pine in question, the plants growing so thickly together as to form often an impenetrable thicket, growing at the same time so vigorously that they add at least two feet to their height annually. Where a fire-line passes through the middle of a blue pine forest nothing can be more striking than the difference in the condition of the protected and of the non-protected portion. Inside the line, the young trees are as thick as wheat in a corn-field, and where there are seed-bearing deodars, seedlings of that species are also coming up in a most satisfactory manner under the fostering care of the young blue pine: outside the line it is rare to see a single seedling. Forests of *Pinus longifolia* are more difficult to protect, as this species never forms a dense forest, and there is, in consequence, a large quantity of long coarse grass covering the ground, whilst the tree being found at lower and hotter elevations fires are of annual occurrence. This pine, however, appears to have in a certain measure adapted itself to this state of things by developing a very thick corky bark, sometimes more than two inches in thickness, which enables it to resist fires more or less successfully, although, when once they have gained access to the wood, the tree is gradually eaten away at the base and finally falls. That reproduction is much retarded by the fires, no reasonable person who has seen much of these forests and has studied them carefully can doubt for a moment; where seedlings are found the spots have probably escaped being burnt for two or three years, for when the young pine has once established itself, even if burnt to the ground, it has a power of coppicing quite unusual amongst conifers. There are no large areas covered with *Pinus longifolia* protected from fire in Jaunsar, but those that have been protected, although they have been burnt on more than one occasion, still show a marked improvement on the neighbouring and unprotected areas.

Having now given my ounce of fact, I will consider the proposals made by "S." (1). That cutting, without permission, of timber be prevented. This rule, I should say, is enforced in almost every Government forest throughout India, and therefore calls for no comment. (2). That needles be burnt under careful supervision *after every fall*. This requires further explanation as to the manner in which the careful supervision is to be exercised. Does "S." think it an easy matter to control a fire when once started, or does he think it possible to prevent seedlings being burnt over such large areas as the Forest Department has to deal with? If he does so, I am compelled to disagree with him, as I believe will all Forest officers and others who have to deal with jungle fires. (3). That seedlings from nurseries be used to fill up gaps caused by fires where carelessness had allowed needle accumulations, or where, from any other cause, the fires had destroyed natural reproduction. Over such vast areas as we have to manage in India natural reproduction

must be our mainstay, and where we can get this it would be simply waste of money to plant. Our planting operations must, therefore, be simply to supplement natural reproduction where this fails, or to form fuel plantations, &c., in places where forests are at present non-existent. What would happen in Jaunsar if we tried to carry out rules 2 and 3? Annual fires not only being allowed, but actually caused by the forest establishment, there would be next to no natural reproduction, and practically the entire area would have to be planted up, if we wished to continue our timber operations and at the same time to conserve our forests. The area protected from fire in this division, containing chiefly deodar, pine and fir, amounts to nearly 100,000 acres, and the cost per acre of planting would be at least Rs. 25, so that we should have to spend 25 lakhs on an operation which nature herself, when assisted by fire protection, has been proved to perform in an infinitely more satisfactory manner.

One of the commonest arguments against fire-protection is that the forests are there in spite of fires; but the reply is that forests have disappeared throughout large areas in India, fire having been the most potent agent in destroying them, and that they are now found usually in remote localities where the population is scanty, but that even in these places, now that the population is increasing, cattle becoming more numerous and grazing requirements more urgent, fires are increasing in frequency, whilst the non-protected forests are visibly dwindling away. Many of the hill forests used scarcely to be worked at all save to supply the few wants of the hill tribes, but the formation of a hill station changes this condition at once, and it becomes an imperative necessity to take the greatest possible care of the neighbouring forests. Of course, if the conditions are such at Murree that fires are bound to occur every couple of years or so, I quite agree with "S." that it would be better not to attempt the protection of the forests; but I cannot imagine how the conditions at that place can be so very different from those at other hill stations, such as Chakrata, Naini Tal and Darjeeling, where fires have been more or less successfully excluded for many years past. If "S." has at any time sufficient leisure to pay Chakrata a visit, I shall be delighted to show him the forests *to which I have referred in this letter, and I feel confident that* his scepticism regarding the utility of fire-protection in pine forests will be changed into a firm belief in its efficacy.

N. HEARLE,

25th May. *Dy. Conservator of Forests.*

As I have lived among or near pine forests for about forty years off and on, perhaps Mr. Hearle will not mind my trying to meet his arguments. In the first place, has it really

been tried fairly whether yearly fires destroy the greater percentage of seedlings? Mr. Hearle says that the *Pinus longifolia* forests in Jaunsar that "have been protected, although they have been burnt on more than one occasion, still show a marked improvement on the neighbouring unprotected areas." Has it really been accurately determined that this improvement has been caused by having a few more fires in the unprotected than the protected portion, or by indiscriminate destruction of trees for timber? The mountain valleys must at least for the past century, if not longer, have been as thickly peopled as now, less the usual percentage of human increase. Their wealth—when the hills were less open to the plains than now—consisted more in their flocks and herds than in their crops. For the cattle the fires were lit yearly, yet good forests stood everywhere till the location of cantonment and sanitaria raised the demand for timber and firewood to an unprecedented extent. Then forests began to disappear. There were indeed previously many mountain slopes—generally overlooking villages—quite denuded of timber, while the slopes adjoining were in many instances still forest clad. This was caused by fires certainly, but fires lit *after* every tree had been felled for the express purpose of leaving the hill bare of trees to aid the growth of grass required during the long winter as hay for the cattle. Where *chir* forests prevailed this was not so necessary, owing to the fact mentioned by Mr. Hearle that the trees generally do not grow in dense masses; while the blue pine had to be cut away entirely to ensure a good growth of hay. And as their timber is so much more valued than that of *chir*, the blue pine and deodar suffered most when cantonments were started.

That fine trees were burnt very often by yearly fires is true, but the cause was generally that scarcely a good sized tree was uninjured, owing to the reckless habit of villagers of hewing out torches from the sides of the finest tree, thereby leaving two or three square feet of wood exposed and cut, from which long streams of turpentine rolled to the ground up which the flames rushed and eat into the very heart of the tree. Can fires be controlled? Mr. Hearle asks. Why not try it and the seedling experiment at the same time? Take an isolated patch of, say, ten acres, have every dry leaf brushed away with thorny bushes and cut the grass. Leave it till next May, then set fire to it against the wind. Have half-a-dozen native boys ready with green boughs to control it; and after it has burnt off, see if seedlings have escaped or not. When we consider the enormous areas under pine forest and the cost of controlling and replanting these, of course it is staggering. But I alluded to the particular forests near Murree. They lie generally along the upper slopes and crests of parallel spurs of mountains, the valleys between being clear of trees and cultivated. The huts of the villages are not, as a rule, in groups, but scattered in twos and threes to the

very verge of the forests, and even lie within the *protected* but non-reserved forests touching on the *reserved ones*. If fires could be prevented as cutting can, of course the results would be excellent. But what is to be gained by protecting seedlings for a few years, if uncontrollable fires must inevitably follow and destroy seedlings, parent trees, and all, as has been the case in Murree despite the thickened bark? This thickened bark which the trees have developed will certainly protect the trees from yearly fires that never rise above six inches in height; but when the flames rise six and eight feet, the lower branches, which have their bark, are first shrivelled by the intense heat, then catch fire and communicate it rapidly from bough to bough, till the top is reached. Meantime whole branches are whirled across twenty and thirty yards into the midst of the tinder awaiting the flames farther on. Stone walls or ditches could control small yearly fires, but the only method by which large fires could be localised when inevitable that I can think of is by having broad clearings made clean across forests. Transverse bars, denuded of trees and kept fairly clear of grass and leaves, would certainly be practicable in the Murree forest, and in most of those lying on the lower slopes of the Himalayas. This might be worth trying if yearly fires are condemned after careful trial. The breadth of clearing required would, of course, depend on circumstances.

S.

ENUMERATION OF KAIL (*Pinus excelsa*) IN THE DEOBAN WORKING CIRCLE.

THE enumeration survey of the Deoban forests was begun last November, and the work has been continued ever since. Up to date the number of green kail trees, all of which have been actually counted except the lowest class, is as follows:—

1	2	3	4	5	6
Diameter Classes.	Over 18".	12"—18".	6"—12".	3"—6".	Under 3" estimated only.
Approximate age in years, ...	over 40	27—49	12—36	6—18	under 8
Number of trees,	9,502	10,020	26,338	91,853	400,000

The age has been calculated on the supposition that the rate of growth of kail in these forests varies between 4·5 and 6 rings per inch of radius.

From the above table it is evident that some of the kail trees in column 4, nearly the whole of those in column 5, and every

single tree in column 6, have been produced since 1872, the date of the beginning of fire-protection. As the villagers have plenty of deodar, and therefore do not fell kail, and as the old trees are so scattered that scarcely any can have died out from over-crowding, we may safely conclude that the Forest Department has succeeded within the past 15 years in producing 500,000 kail on ground which had produced during the era of fires only about 40,000 trees in a period of at least 60 years, that is to say, reproduction has been increased fifty-fold. This is, however, not the only advantage gained, as the trees which are now growing up will be sound, straight, with long boles free of branches, compared with the present mature stock of branchy, crooked and charred stems.

20th June, 1887. N. HEARLE.

A NOTE ON AN OAK OF THE N.-W. HIMALAYA.

Quercus semecarpifolia, here called Karshu, is said in Brandis' Forest Flora to be leafless for a few weeks in the spring. This is not the case in Jaunsar, and at the present time (the 19th of June) in many trees the greater part of the new foliage has appeared, although last year's leaves still greatly predominate in number, only a portion of them having fallen; indeed, it seems probable that many of these leaves will remain for nearly another twelve months. In some years more leaves appear to fall than in others, and it is possible that there may be a certain regularity in the tree's behaviour in this respect, but it is never leafless, and cannot by any stretch of imagination be considered a deciduous tree in these forests. The idea that this supposed deciduousness gave to the oak an advantage over its neighbours the conifers in withstanding the heavy weight of the winter snows, and thus accounted for its being gregarious on the tops of mountains at high elevations, usually between 8,000 and 10,000 feet, may be dismissed as untenable, and taking into account the sturdy character of the oak, as a theory which should never have been advanced, especially as the old leaves fall mainly in April and May after the melting of the snows. This gregariousness in the situations alluded to may be, with much greater reason, attributed to the great quantity of light which the oak seems to require, and also to the fact that the soil is often deeper on the tops of the mountains than along their precipitous sides. Thus in the Deoban Working Circle the summits of the various peaks between the altitudes mentioned are usually somewhat rounded, and are formed geologically of the Mundali series, and are composed mainly of clays and soft shales easily decomposed, producing a deep rich clayey soil eminently suitable to oaks with their long tap roots. Thus it is that the Karshu oak is found cover-

ing the tops of the Deoban, Pandawa and other similarly formed hills in the Working Circle.

The statement in the Flora that the male flowers are in drooping slender catkins 2—3 inches long, the catkins generally fasciculate from the base of the spring shoots, or from the axils of fallen leaves on the previous year's branchlets, whilst the female flowers are in short pedunculate spikes on lateral branchlets, appears to be correct, but the ripe acorns are not on the current year's wood as stated lower down, but on the branchlets of the previous year. In a branch now before me there are the large globose mature acorns at the end of some of last year's branchlets, the dried up remains of the male catkins in the position mentioned above, and the greenish apparently unfertilised styles 3—5 in number, of the female flowers of the year in spikes at the end of the newly-produced shoots. Now, until the male catkins appear in April and May, there are no signs of the coming acorns, but soon after the male catkins begin to shed their pollen, small acorns put in their appearance, and soon swell rapidly to a large size, one inch in diameter, ripening at the very beginning of the rains, when they fall to the ground and germinate immediately. It is, therefore, certain that twelve months elapse from the production of the female flowers to the ripening of the acorns, but is it possible that these female flowers are not fertilised immediately they are produced, but only hereafter by pollen from the catkins of the following year.

The advantages gained to the tree by this procedure would seem to be—

(1). The acorns fall at the very beginning of the rains at the period most suitable for germination, thus enabling the seedlings to establish themselves before the advent of drought and frost.

(2). The acorns, which are very heavy, are supported on the stiff branchlets of the previous year, instead of on the young tender shoots of the year.

What has been said above about fertilisation not taking place immediately the female flowers appear is only suggestive, and no definite conclusion can be drawn until the question has been more thoroughly investigated.

It is also stated in the Flora that this tree attains a larger size than any other oak in the N.-W. Himalayas, but this does not seem to be the case in Jaunsar, where the precedence in this respect should be accorded to the Moru (*Q. dilatata*), which behaves very similarly to the Karshu in its mode of fructification, but although it grows at lower altitudes, and consequently in warmer localities than the former, yet its acorns do not ripen until much later in the year.

20th June, 1887. N. HEARLE.

RING COUNTINGS ON DEODAR STUMPS AT DEOTA FOREST, TIHRI GARHWAL.

Name of block.	No. of tree.	Supposed age of tree (years).	Average radius, inches.	Number of rings. 0″—2″	2″—4″	4″—6″	6″—8″	8″—10″	10″—12″	12″—14″	14″—16″	16″—18″	18″—20″	20″—22″	22″—24″	24″—26″	26″—28″	28″—30″	30″—32″	Aspect.	Remarks.
Jaunsari, ...	1	126	14½	21	16	13	15	17	19	16	...	...	...	...	...	...	...	...	...	S.	Soil is loamy and rock quartzite. The ground is moderately steep. No account is taken of the bark, and in old deodar trees the sapwood rarely exceeds 1½ inches.
	2	123	15	22	16	17	15	14	15	18	...	...	...	...	...	...	...	...	...	N.E.	
	3	201	22	23	26	18	19	22	24	11	14	13	18	...	...	...	...	...	...	E.	
	4	132	12	24	20	22	22	24	20	...	...	...	...	...	...	...	...	...	...	E.	
	5	133	14	18	18	21	22	21	15	18	...	...	...	...	...	...	...	...	...	S.E.	
	6	142	14½	30	25	20	17	18	18	...	...	...	...	...	...	...	...	...	...	N.E.	
	7	221	28	19	25	16	11	9	8	10	10	8	16	18	22	24	25	...	...	S.E.	
	8	151	14½	27	25	19	23	16	18	17	...	...	...	...	...	...	...	...	...	W.	
	9	132	12	20	35	28	18	17	...	...	...	...	...	...	...	...	...	...	...	W.	
	10	125	14	20	20	19	21	16	14	15	...	...	...	...	...	...	...	...	...	W.	
Total and average, ...	10	148·6	16·5	22·4	22·8	19·3	18·3	17·4	16·8	15·0	12	10·5	17·0	18	22	24	25	...	...		

May 1887.

SADANAND, *Forest Ranger.*

SISSU PLANTING.

The system of sissú planting in Gorakhpur has proved to be so highly successful, that I will ask the writer of the article in your May number to clear up certain points in his paras. on cost of planting and financial results, for it is important, in view of an extension of this system, to know accurately the original cost and yearly expenditure on up-keep per acre of this plantation. When the cost per "established tree" is fixed at one anna, this is surely not meant to include charges such as supervision, protection from fire, road-making and share of establishments; still if we wish to arrive at any reliable financial results this expenditure must be taken into consideration, and it would be interesting if these figures could be supplied.

The one anna per established tree, I gather from the article under consideration, is expended as follows—1·2 pie in plant hole, 2·4 pie in transplanting, and 8·4 pie in renewing failures and hot weather watering. I would enquire if there may not be some error in this calculation. Taking the plant hole to have a circular horizontal section, 15 cubic feet of earth is removed from each hole. If 20 holes are dug for 2 annas, the rate would be 8 pie per 100 cubic feet: whereas the ordinary rate for earthwork is 4 annas per 100 cubic feet, and an ordinary 2-anna coolie would probably not succeed in digging more than four holes (*i.e.*, 60 cubic feet) a day. The Rs. 2,000 revenue from grass sales is very satisfactory, but unless the Rs. 6-4 per acre expended on planting operations includes cost of fire conservancy, protection and collection of revenue, this cannot legitimately come under financial results of the plantation. It would be interesting to know what prevents the extension of fire conservancy in a tract which produces Re. 1 an acre from grass alone, and what is the proposed future working of the plantation as regards felling and reproduction.

S. Eardley Wilmot.

PYROXYLIC ACID.

Referring to the extract from the *Timber Trades Journal*, regarding Wood Spirit, or Pyroxylic Acid, I should like to know whether any attempts have ever been made in India to manufacture that or any of the other products of the destructive distillation of wood. I think I have read that in some parts of India, though not in this neighbourhood, difficulty is found in utilizing or selling the inferior kinds of timber which it is desired to exterminate from the Government forests.

Pyroligneous acid is one of the products mentioned, and this reminds me that some forty years ago I saw in Ayrshire, on the estate of a relative, a "secret work," as the country people

called, which had been established by a Glasgow Firm, and at which this substance was produced from the prunings and refuse of felled hard wood, grown on the estate. The acid was sent to the chemical works of the firm, but I do not remember what was there done with it. What I do recollect was that the chemical manufacturers, Turnbull and Co., I think, paid between £500 and £600 a year to the proprietor of that estate alone for the refuse wood they used. Could not inferior woods be thus utilised in India, and the produce either be sold to the chemical works at Calcutta, or exported to Europe?

MUSSOORIE,
13th June, 1887. C. W. HOPE.

LENGTH OF TIGERS.

THIS is a subject on which it would be of interest to obtain reliable information, and with a view of eliciting such, I here give the results of my experience during the past season. In company with another officer, I had the great luck last month of bagging three splendid male tigers. One was an old tiger with his teeth all knocked to pieces, and moreover he had taken to "man-slaying," and there was a special reward for shooting him; the other two were in their prime; they were all got in "beats." The old tiger and one of the others measured each 9 feet 6 inches, but the former was 3 feet 10 inches high while the latter was 3 feet 6 inches. The third tiger was a very thick-set one, and the heaviest of the three, but in length he was 9 feet 4 inches and 3 feet 4 inches in height. The measurements were taken shortly after the animals were shot, from tip of nose along ridge and bend of back to tip of tail; the height was taken from tip of foot to ridge of shoulder. I may mention that I shot these tigers with an Henry's ·500 Express, and they all three rolled over there and then.

CENTRAL PROVINCES,
10th June, 1887. D.

LARGE SIMAL TREE.

AT the very summit of a small hill situated almost in the centre of the Kuttumpollie teak plantations, at the foot of the Coorg ghâts, with an elevation of 700 to 1,000 feet, average rainfall 190 inches, and about 24 miles in a beeline from the sea, stands an enormous *Bombax malabaricum* (simal, púla or cúlí mara), the dimensions of which might interest your readers, as I think it is a "record" tree for Southern India. Its height is 195 feet, girth at 3 feet from ground 102 feet, and at 30 feet from

ground 15 feet, thus shewing the enormous size of its buttresses, which are seven in number, and would easily contain an elephant between any two of them. The situation is, for the locality, a decidedly dry one, and, as I have said above, it crowns the summit of a hill about 300 feet higher than the surrounding country, with fairly steep sides, the angle of slope probably being about 30°, a shallow soil with a gravelly and free subsoil.

J. G. F. M.

COMPOUNDING FOREST OFFENCES.

SECTION 67 of the Act enables certain Forest officers "to accept from any person against whom a reasonable suspicion exists that he has committed any forest offence, other than an offence under Section 61 or 62 a sum of money by way of compensation for *any damage* which may have been committed, &c."*

Now "carrying fire" in a forest closed to fire is an offence under Section 25, but no damage is necessarily done. Is such an offence compoundable under Section 67?

Q.

GERMINATION OF BABUL SEED.

I HAVE had a good deal to do with babul forests and goats. The latter usually wandered about all day feeding, and were herded at night. When we wanted babul seed, we simply collected excreta. Nearly every globule contained one or more. I should say the seed passed through the animal would be far better than that simply shelled out of the mouth. At the same time it is by no means so necessary, as is generally supposed, that the seed and the animal should become acquainted. Common dry seed will germinate perfectly well in a week or two, if only it gets water. Softening the seed in plain water before sowing is a good plan. That recommended by "J. C. Sednem" is better.

FAGOT.

J. C. McD. sends two young male flowers of deodar, gathered on the 4th June, which is the earliest he has ever noticed them, and they are evidently several days old now.

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* We think that the permission to Forest officers to take compensation for offences needs revision and enlargement. In some provinces, more than the value of the damage done is allowed by Government to be enacted, whilst in others only the bare value of the damage may be taken. It is most useful that Forest officers should have power to dispose of petty forest offences in a summary manner, and without the delay and trouble to both parties of recourse to law, and none are more alive to the advantages of the system than the villagers bordering on Government forests.

In the leased forests of the School Circle, there are forests, ten days' journey from a Magistrate qualified to try cases, and to drag petty offenders and the witnesses on both sides this distance and back is obviously inexpedient.—[ED.]

NOTE ON THE QUESTION OF THE ADMISSION OF NATIVES INTO THE INDIAN FOREST SERVICE.*

By B. RIBBENTROP, ESQ., *Officiating Inspector-General of Forests.*

I AM a Hanoverian by birth, and was educated for the higher Forest Service of that country. A few months after the annexation of the Kingdom of Hanover in 1866, I passed an examination into the Superior Forest Service of Prussia, but left almost immediately for India, having been selected for, and having accepted, one of the two appointments in the Indian Forest Service which were offered to German Forest Officers on the advice of the then Inspector-General of Forests, now Sir Dietrich Brandis.

I arrived in the Punjab in March 1867, and was placed in

* Note submitted to the Sub-Committee of the Public Service Commission.

charge of the Jhelum Division, comprising at that time all districts west of the river of that name. In 1870 I was in charge of the Beas Division. During 1871-72 and part of 1873 I held charge of the Plantation Division. During the following year I officiated for 6 months as Conservator of the Punjab, served on special duty connected with Working-Plans, and as Assistant to the Inspector-General of Forests whilst on tour in the North-Western Provinces and Oudh. In 1875 and 1876 I officiated as Conservator of Burma, was Conservator of the Pegu Circle from 1879 to 1882, and was then appointed Conservator of the Punjab. For the last 2 years and 6 months I have been officiating as Inspector-General of Forests.

In recording my opinion on the organization and recruitment of the Indian Forest Service, I presuppose that it is the desire of the Government of India that the State should secure the best servants in proportion to the outlay the Government are enabled to devote from State Revenues for any special purposes of administration, and I refuse to believe in the existence of valid reasons which would make it advisable that the State should be burdened with inferior servants. I do not in any way prejudge, and have carefully weighed my experience of the services of the different classes of servants available for the Forest Department, without a sentimental leaning to either class; but I cannot accept, without a direct assurance to that effect, that the Government is bound to provide employment for educated Natives because they are educated Natives. It is, in my opinion, the duty of the Government to provide the State with the best servants for each kind of work, and to pay them at such market rates as will ensure the maintenance of an efficient service. Every other consideration must land us in uncertainty and doubt.

2. The Indian Forest Service is divided into a Controlling, an Executive, and a Protective Staff. The pay for the Protective Staff ranges from Rs. 6—40 per mensem only; it must, therefore, of necessity, be filled by uneducated Natives, and we need give it no further consideration for the purposes of the present enquiry. The Executive Staff comprises Forest Rangers and Sub-Assistant Conservators. The pay of this Staff ranges at present between Rs. 50—250; and since the appointments have been made as requirements became apparent, and without that strict attention to distribution of the different grades which is necessary for a steady and equal flow of promotion, its organization is open to many objections in that respect, though it has been considerably improved of late years. At present the Executive Staff in the Provinces under the Government of India amounts to 160 officers.

I have always considered a high development of the Executive Staff necessary for a successful and at the same time economical Forest Administration, and I have just recommended a programme under which the number is to be increased in ten

years to 400 Rangers and 50 Sub-Assistant Conservators, with salaries rising, in the case of the latter, according to the following scale :—

10	on Rs.	400	per mensem.
10	„	350	„
10	„	300	„
10	„	250	„
10	„	200	„

My scheme, at the same time, allows for a gradual increase in the pay of Rangers from Rs. 60 to Rs. 150 per mensem ; for, in my opinion, Rangers having the qualifications we now require should not draw less than Rs. 60 a month.

3. The Forest School at Dehra Dún is even now nominally, and will be practically, the sole source of supply for the whole of the Executive Staff. This will, for the next ten years, necessitate the annual training of 38 students for the Provinces under the Government of India ; but there are always some students from Madras and from Native States, and, as the course comprises 21 months, we may count on the continuous presence of from 70 to 100 students, a number sufficiently important to warrant the maintenance of the Forest School at a high degree of efficiency.

At some future time, when the students who have passed through the Forest School have matured in the service as Rangers, I am of opinion that the Sub-Assistant Conservatorships should—if not all, yet as a rule—be filled by this class of men. This is necessary in order to make the Executive Staff in all its branches sufficiently attractive, and will induce good men to enter the Rangers' class. By these means, this branch of the Forest Service will be placed almost entirely at the disposal of Natives ; for Europeans, possessing the necessary qualifications, with perhaps no families sufficiently well off to help them, will not be able to maintain themselves during the time they would draw Rs. 60 to Rs. 150 only.

As yet the number of officers of the Rangers' class who have passed through the School, and have qualified by subsequent approved service, is small, and not sufficient to meet the increase in the number of Sub-Assistant Conservators, appointments which cannot always be deferred without necessitating a more costly and immediate expansion of the Controlling Staff.

4. To meet this demand for Sub-Assistant Conservators, we must have recourse to measures resulting in a more rapid supply of this class of officers. Till now, the provisions of Section 38 of the Forest Department Code have served this purpose ; and we have obtained by these means some very useful officers, and experienced but few failures. All officers but one who were thus admitted into the Department were domiciled Europeans or Eurasians ; the exception was a Mahratta, who is now officiating in the Controlling Staff.

The exception alluded to shows that there is nothing in the rules to prevent a Native from entering the service in this manner; but, as far as I am aware, no other sufficiently qualified Native ever applied either to a Local Government or to the Director of the Forest School. Nevertheless, the working of the section caused a certain amount of dissatisfaction, since the selected officers had of late to pass through the School side by side with the candidates for Rangerships, who sometimes excelled them in mere book learning. I have, therefore, now proposed an alteration in Section 38, under which an Entrance Examination to the Forest School would in future be required, and which would, moreover, provide that the students qualifying for direct appointments as Sub-Assistant Conservators should maintain themselves during the course of their studies, and remain six months longer at the School than in the case of Rangers, in order to study Forest Law and Land Revenue, the Forest Code, and the general principles and rules of administration. These measures will, I think, remove every ground for dissatisfaction on the part of those students who prefer being dry-nursed by Government on a small salary from the time they have passed the University Entrance Examination.

5. Experience shows that an Entrance Examination to the Forest School, even as regard the Rangers' class, is indispensable; for the Entrance Examination of an Indian University is no criterion of a sufficient knowledge of either English or Mathematics, such as is required for the purpose of following even the first and elementary lectures in Forestry.

An Entrance Examination in these two branches of knowledge has consequently been provided for in the future. The Forest School, though in full working order only for the last few years, has turned out some very efficient Range officers and one or two men fit for higher appointments. It is a matter for regret, however, to see that a good many of the young men of pure Native extraction, who were at the School active cricketers and runners, give up their active habits after leaving that institution, and this circumstance is the more marked in the case of those who are placed in charge of timber depôts or revenue stations, under which conditions they are apt to grow fat and comfortable. It frequently happens that the ordinary educated Native does not like the monotony, dangers, and vicissitudes of a forest life. He is afraid of tigers, of fever, and misses life in town. There are, however, many exceptions in this respect, and I know a Maharatta who is always well mounted and rides a good horse well across country, and who did not budge from the side of his Conservator when within easy reach of a charging tigress. This man is a good Forest Officer as well. I know of another Sub-Assistant Conservator, who is, however, not sufficiently well educated for an appointment in the Controlling Staff, but who showed a great degree of character and independence in disal-

lowing his measurements to be disputed, taking upon himself to give the officers in charge of an express fuel train the choice of either accepting his measurements and loading, or of taking the train back empty. This officer is also a good and enduring rider. He is a Northern Mahomedan.

6. There has been a general improvement in the class of Natives we have of late years been able to draw into the service, partly, perhaps, because some of our better men have obtained well-paid appointments in Native States, partly because of the considerable influence exercised by the Forest School as regards both training and recruiting. It is still, however, a matter of considerable difficulty to obtain a sufficient supply of Natives combining physically active habits, a good constitution and strength of character, with a liberal education. That they exist we have proofs, but the Executive Branch of the service must be improved in the manner proposed by me before we can secure them as a rule and not as an exception, as is at present the case.

Exceptionally excellent service in the Executive Staff has, from time to time, been rewarded by translation to the Controlling Staff, and I think that this practice should be continued, though, unless officers thus selected for promotion are sent to England to complete their scientific training, they cannot be utilized for the more important positions for which such training is a question of constantly increasing importance.

7. The Controlling Staff for Forest Administration in India is numerically weak in comparison with the large extent of forests in charge of the Forest Department, and a further development of any considerable extent can, on account of its cost, be approached only with the greatest caution. It is for this reason that I advise the improvement and expansion of the Executive Staff.

It should be self-evident that if it is not possible to expand the Controlling Staff numerically, the greatest possible importance must be attached to the excellence of each officer. We have to train officers who have, at an early age, to take charge of positions in the Forest Administration of the Empire which, in other countries, where forestry has been long established as a separate scientific department, are, as a rule, only filled by officers of more mature experience. The active habits, early-trained powers of observation, and self-reliance of the average young Englishman give us the best material to work upon ; but, in addition to this, we must secure the best possible technical training.

8. The question whether such high technical and scientific training is necessary has been asked and replied to over and over again, and I do not suppose that it is incumbent on me to repeat the arguments in favour of a state of things which has been generally admitted to be necessary, and the defence of which has been set forth at some length in Mr. Fernandez's

evidence, with which I entirely agree. No doubt we have some excellent Forest Officers who have trained and made themselves, *but we can no longer wait for the survival of the fittest in the* way we could afford to do some time ago.

The question which will next arise is—Why this technical training should not be given in India, so as to open the field to all children of the Empire on more equal terms?

For administrative reasons, I would object to educate officers of the Controlling and Executive Staff at one and the same technical school, and even if I considered it otherwise feasible, which I do not (as the training of 100 students for the Executive Staff absorbs the whole power of the School), I would not approve of the Dehra Forest School being developed for the purpose of including the training of officers for the Controlling Staff.

The transfer of the technical training to India would, there*fore, involve the* establishment of a new institution, and there can be no *doubt that educational talent of the kind required is* cheaper in Europe than in India. In Europe, moreover, a college such as we here want can be combined with other scientific institutions, whereas in India a complete staff of Professors would have to be maintained for the education of 8 to 12 students per annum; and if such an institution was at all to equal *the German Schools for the training of Forest Officers for the* Controlling Staff, we should require three Professors of Forestry, besides half a dozen specialists for auxiliary subjects.

I think the question of cost alone should condemn the plan of an Indian training, but there are many other reasons why it is not practicable. Forestry in India is a new departure, and we are not as yet in a position to demonstrate the truths of our *theoretical teaching by easy reference to, and inspection on the* ground of forests long subject to systematic treatment and working. A Forester with European training can draw on his experience of what he has seen, and he can foresee or picture to himself the result of a certain forest treatment; but a student, who has never been shown the results of long-continued scientific *forestry*, would have to take matters on trust. This is a very serious objection, because it would tend to make officers doubtful in regard to the results of their own operations, which they have undertaken because they had been theoretically taught. It is this very want of scientifically directed observation in reference to the results of forestry that only too frequently makes the Civil authorities sceptical as to the wisdom or advisability *of our proposals with regard to Forest Conservancy.*

Next, a Forest Officer on the Controlling Staff ought to see and study saw-mills, tramways, wire trams, slides, forest roads, charcoal-burning, tar manufactories, &c., &c. No doubt we have introduced most of these industries and works into India, but they are scattered over the whole Empire, and it would take a month to show students the timber slide in Chamba and the

sledge-ways in Jaunsar; whereas in Europe all this can be seen in a very short time. I think I have said enough to prove, if not the necessity, at least the advisability of a European training, and, as regards a practical solution of the question, this circumstance should be sufficient.

The recruitment for the service is open to all, and in this respect I need only state that we have both statutory Natives of India and Natives by extraction in the Controlling Branch, both classes having been trained in Europe.

9. The successful recruitment for the Controlling Staff of the Forest Department labours at present under a serious disadvantage, which I think deserves the attention of the Public Service Commission, in so far as the officers in that branch, though selected in the same way and educated in the same college as the officers for the Public Works Department, have neither the same prospects (*the average pay amounting to Rs. 635 per mensem, against Rs. 696 in the Public Works Department*), nor the same pension rules as obtain with the latter. This is a question which seriously affects the recruitment of the best men, and falls, I think, within the range of a Commission whose duty I consider it to be to promulgate proposals by which to secure the most effective servants to the State.

PROFESSOR Sargent, Director of the Arnold Arboretum of Harward College, estimates that five foreign trees are planted in New England to one native. Yet, of all foreign trees introduced into America, the willow alone, he thinks, has qualities not possessed in a greater degree by some native. The European oak is perhaps the most unsatisfactory deciduous tree that has been experimented upon: it grows rapidly when young, *but fails, when about 20 years old, from the cracking of the* main stem, and then, after dragging out a wretched existence a a few years longer, it miserably perishes. The Scotch pine dies long before reaching maturity, and the Austrian and the Corsican pine seem to be no better. The Norway spruce, which has been for many years the most widely cultivated foreign tree in Massachusetts, becomes decrepit and unsightly just at that period of life when trees should become really handsome in full development.—*Nature.*

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FORESTRY IN FRANCE.*

By Major F. Bailey, R.E.

I. INTRODUCTION.

The question of Forest Conservancy occupies, at the present time, a considerable amount of attention in nearly all the countries of the European continent, as well as in other parts of the world.

The use of iron has largely increased of late years, and it is now employed for many purposes which were formerly served by wood. But, at the same time, the general march of civilisation, the development of lines of communication by sea and land, the increase of population, and other circumstances, have caused a rapid growth in the demand for building materials and manufactures of all kinds; so that, notwithstanding the extent to which iron is now made use of, the consumption of wood, so far from being less than it was a few years ago, is much greater.

Countries such as Canada, the United States of America, Russia, Sweden, Norway, Finland, Hungary, Bosnia, Servia, and Roumania, which produce more wood than they need for home consumption, are now exporting largely, in order to supply the markets of other States, whose forests no longer suffice for their own requirements. But in some of them, at least, it is already felt that this cannot go on indefinitely, unless some measures be taken in order to protect the forests from being overworked; and both Russia and Roumania send students to the French and German forest schools. In both these countries a system of forest management has been organised, but some time must necessarily elapse before its effects manifest themselves.

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Belgium also sends its contingent of students to the French School.

In Germany, France, and Austria, the necessity for placing the forests under efficient control, so as to secure a permanent supply of timber and firewood, has long been recognised; and in each of them, a special State Department, with a corps of trained foresters, has been maintained for a long period. In Spain and Italy, where the forests still nominally cover considerable areas, but have been reduced by over-cutting and neglect to an extremely poor condition, endeavours are now being made to restore them, and training schools have been established.

The British Isles are exceptionally situated. Owing, doubtless, to the dense population, and to the facilities which exist for the importation of wood, as well as to the presence of a plentiful supply of coal, the proportion of the surface of our country which is under wood, has been allowed to fall to 4 per cent. of the total area, whereas the average proportion in the other European States is 29½ per cent. Furthermore, such woods as exist are, almost exclusively, private property. Hence it arises that we have no State organisation, for the control and protection of our forests, of the kind, which exists in most of the other countries mentioned above, and no training schools; and it follows from this that the science of forestry, as it is there understood, is, with us, little known. It is true that in India, the Cape, and some other British dependencies and colonies, measures have, of late years, been taken to arrest the destruction which was rapidly over-taking the forests of those countries; but even in India, where a State Forest Department has existed for more than twenty-five years, few persons, outside its ranks, possess even the most elementary ideas regarding the subjects which engross the time and attention of the Forest Officers, or are at all able to understand how they employ themselves while in the forests.

During the last two years, I have had exceptionally favourable opportunities of studying the system of Forest Administration followed in France; and I propose to give a brief description of the excellent organisation, which has, during the last nineteen years, formed the basis of the professional education given to the greater part of the candidates sent out from England to serve in the Indian Forest Department.

My object in writing the following pages is to give an account of the manner in which the State Forest Service of France is organised, with a brief description of the various branches of work which claim the time and attention of the Departmental Staff, and the progress made in each.

In compiling these notes, I have consulted the following works, *viz.*:—

(1). The volume of Forest Statistics, prepared for the Paris

Exhibition of 1878, and giving information to the end of the year 1876.

(2). The Forest Year-book (*Annuaire des Eaux et Forêts*) for 1885.

(3). The French Code of Forest Legislation (Puton).

(4). M. Bénardeau's article, in *La Forêt* for April 1886, regarding the afforestation works in the mountainous regions of France.

(5). The General Programme of Afforestation Works for Algeria (1885).

Statistics on the subjects I have dealt with are not compiled every year; and, as regards those given, I have been obliged to confine myself principally to the figures contained in the first-mentioned of the above works; but I have always given such more recent information as I have been able to obtain.

I am greatly indebted to M. A. Puton, C.I.E., Director of the School at Nancy, who has kindly taken the trouble to read over the whole of my rough notes, and whose valuable suggestions I have thankfully adopted.

NANCY,
1st June, 1886.

FRED. BAILEY.

CHAPTER I.

THE WOODS AND FORESTS OF FRANCE.

In 1876, the last year for which anything like complete details are available, the total wooded area of France, exclusive of isolated trees such as those growing in parks and on roadsides, which were not planted for the sake of the timber they produce, amounted to 35,464 square miles, or a little more than 17 per cent. of the entire area of the country. The proportion in other European countries is as follows, *viz.* :—

Russia, ...	40 per cent.
Sweden, ...	34 „
Norway, ...	29½ „
Germany, ...	26 „
Turkey, ...	22 „
Switzerland, ...	18 „
Greece, ...	14 „
Spain, Belgium, and Holland, each	7 „
Portugal, ...	5 „
The British Isles, ...	4 „
Denmark, ...	3½ „

The average of all the European States, taken together, is 29½ per cent. The population of France being 181 per square mile, it follows that the area of woodland per head is about three-fifths of an acre.

Some changes, which will be noted in a subsequent chapter, have taken place in the area of the State forests since 1876, but in that year the woods and forests were owned in the following proportions by the different classes of proprietors, *viz.* :—

	Square miles.	
The State, ...	3,734 = 10·7	per cent.
Communes and sections of communes,	7,949 = 22·4	„
Public institutions, ...	124 = 0·3	„
Private proprietors, ...	23,657 = 66·6	„
	35,464 = 100	

and these figures may be taken as fairly representing the actual position at the present time.

Forests are not so exhausting to the soil as agricultural crops. In the case of the latter, the entire plant, except the roots, which are sometimes also taken, is removed ; whereas with a crop of trees, the leaves, flowers, and fruit, which are far richer in nutritive elements than the wood, are annually returned to the soil,

and thus serve to maintain its productive power, as well as, by their protective action, to keep it in a good physical condition. Hence forests can flourish on comparatively poor soil; some kinds of trees, notably most of the conifers, being able to grow on ground that would be quite incapable of producing a series of remunerative agricultural crops; and it is therefore, generally speaking out of place to keep rich fertile valleys under forests, which ought rather to be maintained on ground which cannot be profitably cultivated. In well-populated districts, matters naturally tend to settle themselves in this manner; the better classes of ground being brought under the plough, while every acre of the rest of the country is kept wooded, in order to meet the domestic and agricultural wants of a dense population. But it is otherwise in less favoured localities. Here vast areas might be devoted to the production of wood; but while, from the nature of the case, the local consumption is in such places very small, the absence of communications frequently renders export very difficult. Hence wood has but a very small value, and the forests tend to disappear gradually before the excessive grazing to which they are subjected; for the population of such regions, being unable to make its living by agriculture, is, generally speaking, driven to adopt a pastoral life.

Forests grow in France at all altitudes up to about 9,000 or 9,500 feet above the sea, a much larger proportion of them being found at low than at high levels. Thus it has been calculated that if the country, up to the above limit, were divided into altitude-zones of 200 metres each (656 feet), the lowest zone would contain 36 per cent. of the forests, while the highest would not contain more than ·04 per cent. of them; the fifth zone (2,600 to 3,300 feet) would, however, on account of the extensive plateaux existing at this level, contain more than the fourth. Forests situated at high altitudes do not produce so much wood, and are therefore not so profitable, as those which grow lower down; consequently private owners, who have done their best to preserve their woods in the plains and low hills, have, in the majority of cases, allowed the mountain forests they once possessed to be destroyed by over-grazing. Hence it arises that while at altitudes below 4,000 feet, the proportion of State and communal forests is comparatively small, hardly any private woods are found above the level of 6,000 feet, such forests as exist there being, generally speaking, maintained by the State or the communes in the public interest, as a protection against avalanches and the formation of torrents. The private forests are then, taken as a whole, more favourably situated than those which belong to the State and the communes, both as regards soil, climate, means of export, and proximity to the markets. It has been calculated that the distribution of the forest area by zones of altitude is thus proportioned:

	Forests under the Forest Department.		Private and Communal Forests not under the Forest Department.	Total.
	State.	Communal.		
M. M. Ft. Ft.				
Plains, 0 to 200 = 0 to 656	41 %	5 %	45 %	36 %
Low hills, 200 to 500 = 656 to 1640	32 „	48 „	25 „	31 „
Mountains above 500 = above 1640	27 „	47 „	30 „	33 „
	100	100	100	100

It is said that if the trees could be grouped together, so as to form a series of pure forests, the proportion of the total area which would be occupied by each species would be as follows :—

Oak (*Q. sessiliflora* and *Q. pedunculata*),	29	per cent.
Beech, ...	19	„
Hornbeam, ...	12	„
Silver fir, ...	7	„
Scotch pine, ...	4½	„
Evergreen oak (*Q. Ilex*), ...	4	„
Cluster pine, ...	3	„
Spruce, ...	3	„
Larch, ...	2	„
Other kinds, ...	16½	„
	100	

The small number of species which enter to any important extent into the composition of the French forests is very remarkable. Thus it appears that oak, beech, and hornbeam occupy 60 per cent. of the tree-covered area, more than one-half of the remainder being taken up with six other species; but many other kinds are disseminated throughout the forests in various proportions according to circumstances. As a matter of course, however, the trees are not grouped together in the above manner, and, neglecting blanks, the crop on the ground is actually constituted somewhat as follows :—

Pure forests,	Broad-leaved (oak or beech), ...	15		per cent.
	Coniferous (silver fir, pine, spruce, or larch), ...	13		„
			— 28	„
Mixed forests,	Broad-leaved (oak, beech, and hornbeam), ...	52		„
	Broad-leaved and coniferous (beech and silver fir, or oak and pine), ...	18		„
	Coniferous (silver fir and spruce), ...	2		„
			— 72	„
			100	

Or, separating the broad-leaved and the coniferous forests from those which consist of a mixture of the two, we have

Broad-leaved forests, pure and mixed,...	...	67 per cent.
Coniferous forests, ,, ...	...	15 ,,
Broad-leaved and coniferous forests, ...	...	18 ,,

The State forests show a smaller proportion of pure crops than are found in those belonging to communes; but they also comprise a very much larger proportion of forests in which the crop consists of a mixture of broad-leaved and coniferous species. The first of these differences is due to the circumstance that a mixture, which is always desirable from cultural considerations, has been systematically maintained in the State forests from a remote period, whereas this has not always been the case in the communes. The second difference is accounted for by the fact that those parts of the State broad-leaved forests, where, from various causes, the soil has become much deteriorated, have in many cases been planted up with conifers, which are the only kinds likely, on account of their capacity to grow on poor soil, to succeed under such conditions; these trees are, however, only intended to act as nurses to broad-leaved species, which are subsequently to be raised under their shelter. But little work of this kind has yet been accomplished in the communal forests from want of the needful funds. The private forests resemble those belonging to communes rather than those which are State property; but a further comparison in this respect between them and the other classes of forest need not be made at present.

Many circumstances combine together, to influence the nature of the vegetable growth which characterises any particular locality. Thus, a "limestone soil," which is one containing more than four or five per cent. of carbonate of lime, is usually marked by a rich and varied vegetation; while, on a silicious soil, the flora is much more simple and uniform, the undergrowth being often formed of Bilberry (*Vaccinium myrtillus*), broom, and heather. Forty-four per cent. of the French forests are on limestone. But the principal forest trees are not much affected by the chemical composition of the soil—the two deciduous oaks, the beech, hornbeam, silver fir, spruce fir, and larch, being classed as "indifferent" to it. The evergreen oak, however, shows a preference for limestone, and the Scotch pine flourishes best on a silicious soil; but the cluster pine will not grow on limestone. The climate, which varies with the latitude, altitude, amount and distribution of the rainfall, proximity, or otherwise of the sea, and other conditions, is the principal factor in determining the distribution of trees, each of which finds its home in the locality which best suits its temperament. The hot region of the south, the temperate regions of the north and centre, and the mountains, are each characterised by the spontaneous vegetation they produce. Thus, in the south, are found the evergreen oak and the cluster pine; while the spruce, the silver fir, and the larch inhabit the mountains, and the five other species above mentioned, grow chiefly in the temperate

region. The physical condition of the soil also exercises an important influence on the growth and local distribution of trees; thus, for example, both *Quercus pedunculata* and the hornbeam will grow on moist soil, which does not suit either *Quercus sessiliflora*, the beech, or the evergreen oak.

During the entire course of their development, trees of all kinds require light; but during the early stages of their existence, some of them must be completely in the open, without any cover at all; while for others, various degrees of shade are necessary. This quality of the young plants is, frequently, in direct relation to the abundance of the foliage of the adult tree from which they spring. Those which, when young, require much light, such as the larch, the pines, and the oaks, are called "robust," or trees of light cover; while others, which will not stand exposure, such as the beech and silver fir, are called "delicate," or trees of heavy cover. The spruce and the hornbeam are classed intermediately between kinds of light and heavy cover. This is a very important question for the forester, not only with reference to the method to be adopted for raising of a crop of any particular kind of trees, but also with regard to their coppicing power, their effect on the soil, and other matters. Trees of light cover often coppice better than those of heavy cover, but the latter have a much greater effect than the former in improving the soil.

It is estimated that the 35,464 square miles of woods and forests yielded the following produce in 1876, *viz.*, 17,896,227 loads (50 cubic feet) of wood of all qualities, 321,741 tons-weight of tanning bark, 2,556 tons-weight of cork, and 31,539 tons-weight of resin; the whole being valued at £9,471,017. The average production of wood was therefore 39 cubic feet per acre; and the gross revenue, omitting that on minor produce, which was very small, was equal to 8*s.* 4*d.* per acre. But, in addition to this, it is calculated that the isolated trees, not grown for the sake of their timber, and vines, yield together 3½ million loads per annum, valued at £1,000,000; so that the total production of wood in France is raised to about 21½ million loads, and the value of the wood, bark, and resin to about £10,500,000. This brings the amount of wood, and the money value of the forest produce, per head of the population, to 29½ cubic feet and 5*s.* 9*d.* respectively.

Of the 21½ million loads of wood produced, about 4 million loads were timber, and the rest were firewood. The latter sufficed for the national requirements, but the former was far from doing so; for the imports of wood of this class exceeded the exports by 2,062,432 loads, valued at £6,408,000—that is to say, that the production was less than two-thirds of the amount required. The question of foreign timber supply is, therefore, a very important one, even for France, which has 17 per cent. of its area under forest.

CHAPTER II.

FORESTS MANAGED BY THE STATE FOREST DEPARTMENT.

The forest law of 1827, which is still in force, confirmed the previous legislation, under which all woods and forests which form part of the domain of the State, all those which, being the property of Communes or Sections, or of Public Institutions, are susceptible of being worked under a regular system, and finally all those in which the State, the Communes, or Public Institutions possess a proprietary right jointly with private persons, are administered directly by the State Forest Department in accordance with the provisions of the forest law.

The areas thus administered at the commencement of 1885 were as follows, *viz.* :—

	Hectares.		Sq. Miles.
State forests, ...	*1,012,688*	=	*3,910*
Communes, Sections, and Public Institutions, ...	1,967,846	=	7,598
Total, ...	2,980,534	=	11,508

These figures, which include the *dunes*, represent about $5\frac{1}{4}$ per cent. of the entire area of France, and nearly one-third of the total wooded area. An additional 144 square miles of barren land had, up to the end of 1884, been purchased by the State, *in connection with a project for the consolidation of bare and* unstable slopes on the great mountain ranges ; and this area is also administered by the Department under the forest law. About 40 per cent. of the State forests are situated in the plains ; while the rest of them, together with nearly the whole of the communal forests, are found in about equal proportions on low hills, up to an altitude of 1,700 feet, and on the higher mountain ranges. About one-half of them stand on limestone rock, 92 per cent. of their entire area being actually under wood.

The principal object of the following pages is to sketch, in a *brief and summary manner, the system of management adopted* for these forests ; so that some general idea may be formed of what the business of the French Forest Department consists in, and what the results of their labours have been, up to the latest date to which information is available under each head. The organisation of the professional staff of the department, and the manner in which it is recruited, will then be explained.

STATE FORESTS.

The forests now belonging to the State owe their origin to one or other of the following sources. Either they formed part of the ancient royal domain, as it was constituted at the time of the ordinance of 1669, or of the sovereign domains united

to France since that year ; or else they were ecclesiastical property, confiscated at the time of the Revolution in 1790 ; or they have been more recently acquired by purchase, legacy, or gift. About one-half of them are ancient royal domains.

The State forests were formerly of much greater extent than they are at present. In 1791 they covered an area of 18,166 square miles, which was reduced to 3,792 square miles in 1876, the reduction being almost solely due to sales effected for the benefit of the exchequer ; but the loss of territory after the war of 1870 was the cause of a diminution of 374 square miles. The records show that, between 1814 and 1870, 1,362 square miles of State forests were sold for nearly 12¼ million pounds sterling, or about £14 per acre ; but since 1870 no such sales have taken place, and since 1876 the area has been somewhat increased by purchases and otherwise. It now includes 33 square miles of forest owned jointly with private persons, and 450 acres temporarily held by the families of some of Napoleon I.'s generals, whose right will, in the course of time, either lapse or be commuted. The remainder of the area is owned absolutely by the State ; but the enjoyment of the produce does not belong exclusively to the treasury, for, as will be explained hereafter, certain groups of right-holders participate in it.

In the next section, the principal points of the laws relating to the communal forests, and of their management by the State Forest Department, will be brought to notice ; while, in the subsequent sections of this chapter, the work of the Department in connection with the State and the communal forests will be briefly treated of, in such a manner as to bring out and compare the results obtained in the two classes of forests.

Forests belonging to Communes, Sections, and Public Institutions.

The territory of France is divided into 39,989 communes or village communities, of which about one-third are forest proprietors. Certain groups or sections of the inhabitants have, however, rights, and own property, apart from the commune in which they reside ; and these are also owners of considerable areas of woodland. Those forests belonging to communes or sections, which are susceptible of being worked on a regular system, are managed directly by the State Forest Department, for the benefit of their owners, the principal features of this management being as follows, *viz.*,—The laws relating to State forests are, generally speaking, but with certain exceptions, applicable to them ; they cannot be alienated or cleared without the express and special sanction of Government in each case ; they cannot be divided up among the members of the community ; the annual sales of produce are effected by the State forest officers, and the money realised is paid directly by the purchasers

into the communal treasury; before the sales take place, the quantity of timber and firewood required by the inhabitants for their own use, is made over to them, usually standing in the forest, and it is subsequently worked out by a responsible contractor; three-quarters only of the total annual yield is available for distribution or sale, the remaining quarter being left to accumulate, and thus to form a reserve fund or stock of timber, from which exceptional necessities, either in the way of wood or money, can be met; the distribution of firewood is made according to the number of heads of families having a real and fixed domicile in the commune; the entry of goats into the forest is absolutely prohibited, while the grazing of sheep is only permitted temporarily, and under exceptional circumstances, with the special sanction of Government in each case; no grazing of any kind can be carried on in the forests, except in places declared out of danger by the forest officers, who have the power to limit the extent to which it can be practised, with reference to the quantity of grass available; the forest guards are chosen by the communal authorities, subject to the approval of the forest officer, who delivers to them their warrants; the State defrays all expenses of *management*, including the officers' salaries, the marking of trees, notifying of sales, office charges, and the prosecution of offences; the State is reimbursed by the payment, from the communal treasury, of a sum equal to 5 per cent. on the sales of principal produce, including the value of the wood made over to the inhabitants; but this payment, which forms a first charge on the forest revenue, can never exceed the rate of one franc per hectare (about 4*d.* an acre) of the total area thus managed; the communes pay the guards' salaries, the taxes, and all charges for the maintenance and improvement of the forest, including planting, sowing, and road-making, as well as the cost of extraordinary works, such as demarcation, survey, and the preparation of working plans. In all this, the forest officers are bound, by law, to act on the principle that they are managing the property *for the benefit of its owners*, who must be consulted through their representatives, the Mayor and the municipal council, in all matters affecting their interests, and whose wishes must be acceded to, when they are not opposed by the legislation, or contrary to the recognised principles of scientific forest management.

The principal public institutions are hospitals, charitable associations, churches, cathedral chapters, colleges, and schools; and the forests belonging to them are subject to administration by the State Forest Department, on precisely the same terms as are those of the communes and sections.

Of the area of 7,598 square miles, shown as being thus managed on behalf of these bodies at the commencement of 1885, about 100 square miles belong to public institutions, and about 7,500 square miles to communes, including sections. Of the

remainder of their forests, about 410 square miles owned by the latter, and about 27 square miles by the former, are managed, respectively, by the communes themselves under the municipal laws, and by the administrative councils of the institutions.

Changes in this respect frequently take place ; for every year a certain number of applications, to free forests from the restrictions which State control involves, are granted, while in other cases the owners demand or consent to their imposition. The records show that sanction has, since the year 1855, been accorded to the clearance of 35 square miles, and to the alienation of 40 square miles, of the forests belonging to these bodies ; but it is probable that the permission given, has not, in all cases, been acted on.

For the sake of convenience, the forests belonging to communes, sections, and public institutions, will in future be spoken of collectively as "communal" forests.

Demarcation and Survey.

Up to the end of 1876, the work of demarcation had made good progress in the State forests, only 13 per cent. of which then remained to be completed, while 30 per cent. of the communal forests had still to be dealt with. The demarcation is effected by means of dressed-stone pillars, with intermediate ditches or dry-stone walls, according to the custom and resources of each locality. The ground is usually re-surveyed after the demarcation has been completed ; and at the end of 1876 about three-fourths of the State forests and one-half of the communal forests had been thus re-surveyed and mapped, the prevailing scale being $\frac{1}{5000}$ ($12\frac{2}{3}'' = 1$ mile) and $\frac{1}{10000}$ ($6\frac{1}{3}'' = 1$ mile). Pending the completion of this work, the old maps are used for such of the forests as have not yet been re-surveyed. In the communal forests the work of demarcation and survey is less advanced than in the State forests, because the charges for such work have to be defrayed from the communal treasury, and the needful funds are not always forthcoming.

Systems of Culture.

The climate of France is singularly favourable to the natural regeneration of forests, which is, generally speaking, relied on—planting and sowing being resorted to in the comparatively rare instances in which success cannot otherwise be achieved, such cases including, of course, the stocking of extensive blanks.

There are two main systems of culture—one known as "high-forest," and the other as "coppice."

A High-forest, which is usually destined to produce timber

of large size, is one composed of trees that have been raised from seed, its regeneration being effected by means of seeds, generally speaking self-sown. There are two methods of treating the forest in order to produce this result. In one of these, the trees of each age-class are grouped together, and are subjected to periodical thinnings, until the time arrives for regeneration. This is effected by a series of fellings, the first of which is a more or less light thinning, intended to promote the formation of seed, and the springing up of the young seedling plants. The "seed-felling," as this is called, is followed at intervals by a series of "secondary fellings," usually three or four in number, which are made in order to meet the gradually increasing requirements of the young growth in the way of light; and ultimately the remainder of the old stock is removed by a "final felling." In this manner, the marketable stems are gradually cut down and disposed of, the young crop being left to go through the same stages as its predecessor, and so on throughout successive generations of trees. In the selection method (known as *jardinage*), on the contrary, the trees of all ages are mixed over the whole area of the forest; there are no regular thinnings of the kind made under the first method; and the annual cuttings are effected by taking marketable trees here and there, within a certain area of the forest, the blocks composing which are successively treated in the same manner, so that the entire forest is worked over within a fixed period of time. When treated by the first method, the forest is grown under very artificial conditions; for the age-classes are never in nature found thus grouped together. By the selection method, on the contrary, a more or less near approach to a natural forest is obtained.

In the COPPICE system, the regeneration is principally effected by means of coppice shoots. There are two methods of treatment—*simple coppice*, in which there are no reserved trees, and the crop is clean-felled over successive portions of the forest; and *coppice with standards*, in which standard trees are selected and reserved, with a view to their remaining throughout several generations of coppice shoots—generally at least three, but often four or five. Many forests are now undergoing conversion from the system of coppice to that of high-forest.

The following statement shows the extent to which the two systems were applied, in the State and communal forests, in 1876, since which year no important changes have taken place. The areas are given in square miles :—

	High-forest.	Under Conversion.	Coppice.	Pastures.	Total.
State forests, ...	1,648	1,121	740	225	3,734
Communal forests, ...	2,229	54	4,808	92	7,183
Total, ...	3,877	1,175	5,548	317	10,917

It will be seen that there is a marked difference between the State and the communal forests in this respect. In the former, nearly three-quarters of the total area are either now under high-forest, or under conversion to that system; while in the latter, two-thirds of the total area are under coppice, and less than one-third is either under high-forest or under conversion.

High-forest, being usually destined to produce large timber, the trees must be left standing until they have attained a considerable age; and the capital, both in timber and money, which is locked up in it, is therefore much larger than that in a forest under coppice. Other conditions being equal, the quantity of wood produced annually is, however, much the same under both systems. But owing to the greater value of the produce obtained from high-forest, its money revenue is greater than that of coppice; while, on the other hand, it is found that coppice yields a higher rate of interest on its smaller capital value than high-forest, and on this account it is a more suitable system for adoption by communes. Coppice possesses, also, a further advantage for them, in that it yields, for the use of the inhabitants, timber and other produce more varied in kind and dimensions than are obtainable from high-forest; and it thus satisfies their requirements, which are chiefly in fuel and small-sized timber, better than forest managed under the latter system. But even in cases where the conversion of communal coppice to high-forest is deemed advisable, it is always found difficult to reduce the annual fellings sufficiently to allow the growing stock to accumulate to the required extent; while the small size of the greater part of these forests renders them unsuited to the treatment they would have to undergo, in order to effect their conversion. The coppice system, including coppice with standards, is therefore in vogue in almost all communal broad-leaved forests; such high-forest as the communes possess being found chiefly in mountainous regions, and being composed of coniferous trees, which will not coppice. The area of communal forest, shown as under conversion, consists principally of tracts in which the coniferous trees are spontaneously taking possession of the ground, and driving out the broad-leaved species.

It follows, from what has been said above, that the State alone can, generally speaking, afford to raise broad-leaved high-forest on a large scale, or undertake the conversion of coppice to high-forest.

A further difference between the systems of culture generally adopted for the State and the communal forests may be noted, *viz.*, that whereas, in the former, less than one-fifth of the high-forest is treated by the selection method, three-fourths of the communal forests are so treated. In mountainous regions, where, as has just been said, the greater part of the communal high-forest is found, the selection method possesses incontest-

able advantages, in consequence of the continuous cover which it affords to the soil; but although the respective merits of the two methods, as applied to coniferous forests situated in such regions, are much disputed at present, there has of late years been an undoubted tendency to return to selection, which has for some time past fallen into discredit, and, taking the State and communal forests together, somewhat more than one-half of the total area of their high-forest is now treated in this manner.

(*To be continued*).

TOUR THROUGH COLORADO AND VISIT TO OTTAWA CITY, AMERICA.

After a sojourn of three days during June 1886 at Salt Lake city, which place does not seem to be in a very flourishing condition at present, Mormonism being decidedly on the wane, I started *viâ* the Rio Grand and Denver Railway for Monatu springs situated on the western side of the Rocky mountains. This is a newly constructed line on the metre gauge system, and the scenery through which it passes includes some of the most famous Canons of Colorado.

After passing Gunnison city, which is a new looking town situated in the middle of a bare plain, the principal occupation of the inhabitants being apparently that of cattle grazing, we ran for about 100 miles along the borders of the Rio Grand river, and then entered what is called the black or Gunnison Canon.

The scenery of this Canon, the literal meaning of which term is a deep valley, is truly grand, and must be seen to be appreciated.

The mountains tower up on each side to 2,000 feet in perpendicular height, and the valley is so narrow at the bottom that there is barely room left for the railway line, which runs close to the edge of the Rio Grand river.

The hill-sides, which consist of masses of limestone rock, are extremely bare of tree vegetation, and very little verdure of any kind is to be seen.

After passing Solida city, the inhabitants of which are principally engaged in the mining industry, the State of Colorado being famous for its silver, copper, and iron mines. The railway line rapidly ascends towards what is called the Marshall Pass, which forms the Continental divide or water-shed between Eastern and Western America.

The line ascends this pass in a series of zig-zags, some of the curves being extremely sharp, and the top is at last reached at

an altitude of about 7,500 feet. On both sides of this pass extensive pine forests are passed through, where the damage caused by forest fires is seen in the most striking manner, hundreds of square miles being covered with blackened stumps.

This reckless destruction of valuable timber is due, I was told, to the absence of all forest conservancy arrangement in this region, the conflagrations being caused by sparks from the passing locomotives, or to the carelessness of squatters or sportsmen.

The whole scene has a most depressing effect on a forest officer, especially when one observes that in most places where the forest has been burnt, a rank growth of willows, poplars and birches is rapidly taking the place of the former pine forest.

The accompanying Plate shows a station at the top of the pass, situated in the middle of the burnt pine forest, the entrance to the snow sheds being seen on the left. As snow lies in these regions 5 or 6 feet deep for several months of the year, the plan of constructing strong sheds at the most exposed places, the total length of which is about 30 miles, has been adopted, which arrangement enables traffic to be continued all the year round.

After crossing the pass, we descended for several hours at a furious pace, and then entered what is called the Royal Gorge situated in the Grand Canon of the Arkansas river.

The total length of this Canon is about six miles, the mountains running up in almost perpendicular cliffs of 3,000 or 4,000 feet on each side, there being scarcely room left for the river and the railway line at the bottom.

The pace at which this dangerous defile, with steep gradients and sharp curves, is traversed, is rather startling, and this route should certainly not be taken by nervous travellers. After leaving the Royal Gorge the country assumes more the appearance of a plateau, and continues so till Monatu springs is reached, the total time of the run from Salt Lake city having been about 30 hours. I made a short sojourn of two days at Monatu, which is situated at 6,125 feet above sea level, and is famous for its mineral springs, and then took train for Chicago, following what is called the Grand Burlington route.

The States through which this line passes are Nebraska, Iowa, and Illinois, which mostly consist of rolling grass prairies with few trees and little cultivation, the temporary looking villages having a very new and unsettled appearance. However, as Chicago is approached, the country assumes quite an English aspect with well built towns and villages, fenced fields and fine clumps of trees.

The city of Chicago, situated on the border of lake Michigan, is of vast extent and imposing appearance, with fine streets and magnificent hotels and public buildings. I of course visited the site of the great fire of 1871, the area of which was 3½ square

miles, the conflagration having been caused by a cow kicking over a kerosine lamp.

This vast area, which at the time was thickly packed with houses mainly built of timber, was completely burnt over in about three days, one house only, which happened to be surrounded by a grove of trees, having escaped.

Besides its grain, railway plant manufacture, and timber trade, the city of Chicago does a vast business in the curing and export of meat to all parts of the world, the stock-yards covering an area of 380 acres. Some idea of the vast extent of this trade may be formed from the fact that the establishment of Messrs. Armourer and Co., which I visited, disposes of as many as one million three hundred thousand hogs, and about four lakhs of cattle and sheep annually, besides which there are eight or nine other companies which do an almost equally large trade in cold meat.

After seeing all the main sights of Chicago, I started on the 20th June for Ottawa city, the capital of Canada, visiting of course the famous falls of Niagara *en route*, a description of which I shall not attempt here, and will content myself with stating that my anticipations were not in the least disappointed. The city of Ottawa, besides being remarkable for the magnificence of its fine public buildings, is also famous for its extensive timber trade.

The city is situated on the river of the same name, which drains an extensive area of the Dominion covered with immense pine forest, most of which has been leased by large timber companies. Enormous quantities of timber are felled in these forests during the winter and spring months, and floated down the river to Ottawa, the work being principally done by French lumbermen.

Immediately above Ottawa the river suddenly precipitates itself over a rocky ledge called the Chaudière falls, the total height of which is about 50 feet, and as there is an immense body of water available, this place is particularly suitable for the working of saw-mills. At this point, therefore, 10 or 12 important saw-mills have been established, the largest of which, that of Messrs. Booth and Co.'s, I had the privilege of inspecting.

This Company possesses about 2,000 square miles of forest, situated about 200 miles up the river, and during six months of the year their mill cuts up 2,000 logs of timber daily, 100 saws being constantly at work. As there are 10 or 12 other companies with about as extensive a trade as that of Messrs. Booth, some idea of the vast importance of the Ottawa timber trade may be formed. The logs are brought down in lengths of from 12 to 15 feet, the average girth being 7 to 8 feet. I observed, however, much smaller logs being sawn up, which fact, joined to the complaint of some of the mill owners regarding the want of a sufficient supply of timber, points to the rapid exhaustion of the forests of the upper Ottawa river.

On this point I made careful enquiry from Messrs. Booth's

agent, who stated that if the forests are fortunate enough to escape from fire, fellings can be made after each succeeding period of 20 or 25 years, but the information obtained on this head was of course extremely vague. On arrival at the mills the logs are cut up into various kinds of scantlings, called "battens," of different lengths, and not less than two inches in thickness, which are mainly exported to Europe *viâ* Quebec. All the smaller refuse wood is cut up into shingles, small planks or staves for making pails, and the still smaller pieces are cut up into wood for matches. Notwithstanding the legislation which has taken place prohibiting the throwing of saw dust into the Ottawa river, the mill owners, who are influential men, still continue to pour all this material into the Ottawa, and the result is that the river is gradually becoming choked up, and fish are said to have become extremely scarce, or have altogether disappeared. There being several other saw-mills lower down the river, large quantities of logs are taken past the Chaudière falls by means of a side channel.

This consists of a canal half a mile long, 15 feet wide, the water being about 3 feet deep, and with a steep gradient down which small rafts of logs are brought at a terrific pace.

Perhaps some of the readers of the "Indian Forester" may recollect that the shooting of this canal, sitting on a raft, was one of the exciting adventures provided for the entertainment of H. R. H. the Prince of Wales on the occasion of his visit to Canada about 20 years ago.

After these rafts have passed down the canal they are united into very large ones, which are then towed down the river by means of steam tugs, one immense raft represented in the accompanying Plate, being valued at 45,000 dollars, or about £10,000.

In other cases the logs are not bound together in rafts, but are surrounded by a boom of timber, which is attached to the tug by means of a strong hawser.

On going down the river I observed one of these rafts which contained I was told 6,000 logs, and much larger collections of timber are often moved along in this way.

Some idea of the extent of the timber trade on one of the American rivers may be drawn from the fact that in June 1886, a jam occurred of over a lakh of logs, in order to remove which the united efforts of three steam tugs and 500 men were required during a period of one month. After a pleasant sail of 10 hours down the Ottawa river we approached the famous Lachine rapids, down which the steamer shot at a tremendous pace, and soon after passing under the renowned Victoria tubular bridge, which spans the St. Lawrence in a majestic manner, we arrived at the beautiful city of Montreal.

19th July, 1887. E. McA. M.

IMPORTS OF TIMBER INTO BURMA.

I SEND herewith a statement of entries and clearances from the Kado depôt, which may interest your readers in general, but more particularly those in Burma.

The Kado depôt is about 5 miles above Moulmein. All timber from beyond British territory which arrives *by the Salween and its tributaries* has to be reported there, and is stored on ground which is allotted by Government for the purpose. The timber remains at the depôt until it is purchased and removed to Moulmein, where it is prepared for the market in some of the numerous saw-mills in that town. A small charge of ½ per cent. on the amount realized by the sale of the timber from Kado is charged to the purchaser to cover the expenses which are incurred in controlling and regulating the floating of the timber.

It will be seen that the quantity of timber arriving from the States beyond our frontier has been large this year, notwithstanding the fact of the Burmese war and annexation. Most of the timber comes from Siam and its tributary States, whilst a great deal comes from small Shan States whose suzerainty to the King of Burma was more or less nominal.

The number of logs entered up to the 26th February during the official year 1886-87 has been no less than 1,48,506, whilst the clearances have been 1,27,870. The number of logs which had passed the Upper Guard station was 1,51,875. (The Upper Guard station is a guard-house at the entrance of the Kado creek. A book is kept here showing the number of rafts which enter the Kado creek, as well as the number of logs in each. The figure as to number of logs passing the Upper Guard house is apt to vary from that given as total of the entries, as on arrival in the creek, the timber may be either reported immediately in the office, or it may be reported anytime within the succeeding week. Hence the total shown as having passed the Upper Guard house is invariably larger than the total shown as entered and reported).

Note.—The total number of logs entered during the official year 1886-87 was as follows:—

Full-sized logs.	Under-sized logs.	Crooks and stem-pieces.	Total.
1,12,108	28,055	8,343	1,48,506

The following Table showing the imports of teak timber from Upper Burma into Lower Burma by the two principal streams,

the Irrawaddy and the Sittang, for the last 5 years, will also probably prove of interest to your readers at the present time :—

By the Irrawaddy.

Description of timber.	1882-83.	1883-84.	1884-85.	1885-86.	1886-87.
Teak logs, ...	15,637	15,214	36,218	12,393	30,787
" squares, ...	1,625	...	3,730	784	858
" pieces, ...	...	3,768	...	...	...
" planks, ...	103	2,809	1,098	944	181
" boat-pieces, ...	31	45	234	305	*Nil.*
" wheel-pieces,... ...	5,220	22,458	60,930	61,685	9,610
" oar-pieces, ...	...	*1,318*	*1,137*	*415*	*200*

By the Sittang.

Teak logs, ...	*27,126	32,621	43,864	61,265	17,557
Total, ...	49,742	78,233	147,212	137,791	59,193

The season for floating down timber to Rangoon by the Irrawaddy from Upper Burma is the dry weather. The expedition which took place at the commencement of the dry season of 1885-86 interfered considerably with the outturn during that year, but it is manifest from the figures that a revival took place during 1886-87, and with the country gradually settling down we may anticipate a very much enlarged outturn during the coming year.

The season for floating timber by the Sittang is the rainy season. The work of cutting and trimming the logs is done as in Lower Burma during the dry weather, and during the rains the floating operations take place. It will be noted that the outturn of logs had been gradually increasing up to 1885-86, when the outturn was the largest on record. At the time of the expedition, floating operations for the season had, practically finished, hence the outturn for 1885-86 was not influenced by the war. But during the dry season of 1885-86 the country at the sources of, and drained by, the Sittang was in a very unsettled condition. Large organized gangs of dacoits put a

* In addition to some 8,000 logs which drifted away and were not reported.

stop to all work. Hence the low outturn during 1886-87. In the future we may expect good outturns, as the country is now settling down.

It will be noted that the official statements for the Irrawaddy show, in addition to logs and squares, which are invariably for the Rangoon market, smaller categories of timber described as pieces, planks, boat-pieces, wheel-pieces and oar-pieces. These usually supply the inhabitants of the large villages bordering the Irrawaddy in Lower Burma with building materials and materials for their carts and boats, two almost indispensable articles to a Burman. Along the Sittang in Lower Burma the villages are fewer, and their demands in this way are met locally. Consequently the whole of the timber arriving by the Sittang finds its way to the Rangoon market.

THARAWADDY,
29th May, 1887. T. H. A.

THE INDIAN FOREST SERVICE.

I READ the article on the Indian Forest Service in the "Indian Agriculturist" and your comments on it in March's Number with much interest.

It is certainly "well for us all to know what non-foresters think of our work," even when they betray such a want of knowledge of its scope as does the writer in the "Indian Agriculturist." The more the subject is ventilated, and the real nature of the duties to be performed and attainments required of a Forest officer understood, the better it will be for the Department and its officers of the future.

I am entirely in accord with the "Indian Agriculturist" that the pay and prospects of our Assistant Conservators is not commensurate with their expensive education, and the high standard of attainments required of them. I think Government could well afford to improve the pay and reduce the expense of education by liberal grants-in-aid, but certainly not to lower the standard, which is absolutely necessary to ensure proper forest administration. On the other hand it may with force be argued that so long as Government can obtain the class of highly educated men which it requires on the present rates of pay, and notwithstanding the cost of their education, why should it offer more?

The Forest officer of the Controlling staff costs the State little or nothing in return for a liberal education, both general and special, whilst the Forest officer of the Subordinate staff "the Native youth, including the Eurasian community," of the "Indian Agriculturist" either costs the State a good deal for general and special education, or is found utterly unfit for the responsible and highly honorable position of a Forest Range officer.

When the writer goes on to state that the need of European

guidance in the Forest Service has now gone, and "that it is in India itself we should now recruit the service without a thought of resorting to England for the purpose," he betrays such a lamentable ignorance of the subject, and such a lack of the "common sense" which he refers to, that it is almost waste of time to endeavour to combat his assertions.

Giving him, however, credit for *bonâ fides*, and lest his arguments and deductions if not challenged, might be accepted as proved by the readers of the "Indian Agriculturist," it appears advisable to give them an unqualified denial.

We have as yet merely commenced the creation of the forest estates of the future; indeed, in most Provinces have not completed their selection and settlement as reserved forests, pending which no real progress can be made in their protection and the improvement and development of their resources. The relatively *small staff of Forest officers, whether trained in Europe or India*, have worked nobly in the face of difficulties, which at times have appeared overwhelming, in order to secure and protect at least a nucleus of State forests free from or not overburdened with rights, but the good work is by no means completed, and every square mile added to the area increases the need of proper professional and trustworthy management.

The cry for more officers both of the Controlling and Executive staff is universal from all Provinces, and the more it meets with a response, the more do the value of the forest estates and the forest revenues increase.

Our department has always been ready to accept, and anxious to secure, native agency to recruit its ranks, but unfortunately it has been found that, *as a rule*, Natives are not a success. The fact is indeed patent to all that the nature of the duties is uncongenial to natives, and especially to the Hindu of Southern India, who would never enter a forest of his own free will, still less make it his home for months, and only joins the department in order to make it a stepping stone to the Revenue or some more congenial line, or in view to the pay and pickings which *he hopes to enjoy, whilst seeing as little of the "jungle" as he* possibly can.

We hope to overcome this, and create a race of Foresters with their hearts in their profession by degrees, but it cannot be too clearly understood that the race, both as regards attainments and proclivities, has still to be created, and that it will take many years, probably at least one generation, to do it.

It is in this respect that we look with confidence, and I think with justice, to the benefits of the training at the Forest School, Dehra Dún. It is not only the general and technical education imparted, but the *esprit de corps*, habits of observation and interest in their profession developed which does so much good, and has led experienced Forest officers of all Provinces to appreciate the advantages of the course of study at Dehra.

To become a good Forest officer, in whatever class or grade, a man must in my opinion not merely study forestry theoretically, he must live in, and so to speak, breathe an atmosphere of forests, and become imbued with the instincts and proclivities of a Forester.

To assert that such instincts, apart altogether from mere book learning, are inherent amongst the natives of India of the present day, is I consider palpably erroneous, and capable of ready disproof by the hard logic of facts.

When the Natives of India are ready to devote their youth and their own or their parents' money to acquiring a thorough knowledge of scientific Forestry, and then devote their lives to its practice as is done in France and Germany, then, and not till then, may they or the "Indian Agriculturist" claim for them a monopoly in the Forest administration of this great Empire.

What we have to do is to obtain the best men we can, improve their position, pay and prospects, in order not only to obtain, but to retain their services, and through their teaching and practical work, to teach the public, including the writer in the "Indian Agriculturist," what "Forestry" means, and the enormous benefit to this country, which we believe will result from its intelligent and persistent practice on broad and liberal principles.

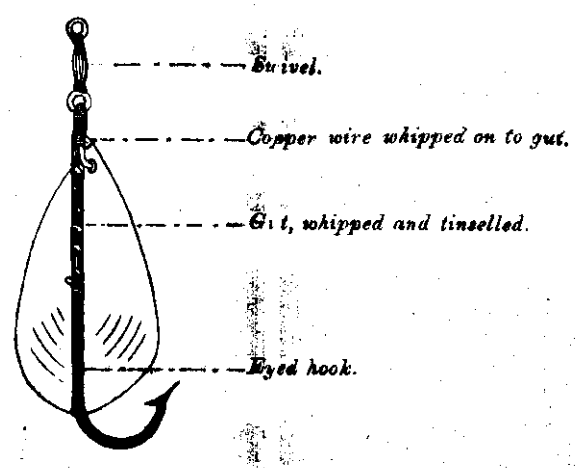
VETERAN.

A FILLIP TO SENIOR ANGLERS.

As far as I can remember since the first publication of the "Indian Forester," not a single contribution has been inserted on the subject of fishing, and this is the more curious as the Department includes some good anglers, besides many who, preferring this sport to any other, are in a fair way to become so. To me it is most unsatisfactory to observe that the former class will not *deign to assist the latter with hints, which would save much* tackle and temper, or amuse and excite them with soul-stirring anecdotes on paper, but are content to enjoy calm chuckling retrospections of fearful tussles with big fish, and the not less enjoyable strolls along mountain streams, resulting in the death of two or three dozen trout. Let us suppose for instance that the Forest officer, who in two successive casts hooked a 19 and a 16-pounder, and after three-quarters-of-an-hour's hard work, was borne with his victims to his bungalow, exhausted by the heat of May, and the excitement of light tackle, with a jumping fiend at the end of it, had given us a *detail of his sentiments in the* "Forester." How readily would we, after absorbing all the technical and statistical articles in that periodical, have turned to his recital with fingers tingling and ears buzzing with the

whir of the line. I believe privately that a contempt of check winches resulted in his getting the tingle without the whir, and then calm after-thought prompted him to eschew the use of the pen for a time. Or what a good story the other Forest officer (after the humour of it had been explained to him) might have made immortal in these pages, fascinated by the eagerness the trout were showing for a may-fly, he did not perceive the proximity of a large tusker until retreat could only be secured by loss of dignity. Speaking seriously and remembering that Fishing Clubs now exist in Upper India, also the large share Forest officers may have in preserving fish, the "Indian Forester" might become the oracle of that sport, and secure contributions from anglers and others interested in the matter. I would like to tap the store of information and observation which has accumulated almost in silence for many years. In the first place why are some *mahsir black?* quite black above and smoky instead of orange on the belly, not out of condition to look at, but still uncanny and not to be eaten if others are available. Has this to do with the nature of the river bed? Secondly, what do mahsir eat in the cold season when they lie head to tail in the quiet pools, and refuse every kind of provender provided for them. If netted, speared or shot, they are found to be in good order, and I decline to accept the native idea that they eat mud. How delightful it would be if some one would tell us how to incite the winter mahsir to eat a hook in a legitimate manner; nothing would be too good for that man, he should receive his pay in English dollars and have asbestos fire-lines.

However it is easy to ask questions and not much fun answering them, so I must endeavour to make up for my obtrusiveness by sending a sketch of a spoon mount evolved by an enthusias-



tic young one. It does away with split rings and treble grap-

nels, which are always breaking and wobbling ; it is simple, light and never hooks foul, spins excellently, and during the last season has been an inducement to land maunds of mahsir and trout.

Try it, and express your gratitude by confiding to the Editor your fishy adventures and experiences.

EYED HOOKS.

A PLEA FOR SYSTEMATIC BOTANY.

I HEAR with regret that this subject is no longer to be an obligatory one at the Forest School for the Rangers' certificate, but is simply to remain one for honors.* This ruling practically abolishes it from the curriculum of the School, where the use of the microscope and the study of insects are still compulsory. I would enquire whether it be really considered more important for Forest Rangers to be able to manipulate a microscope, which instrument probably not one in *fifty of them will ever* use or even see again after leaving the School, or to be able to use the Forest Flora of their province, and thereby learn all about the properties and uses of the trees in their district ; or again, can the system be considered a practical one which insists on a Ranger knowing the entomological differences between a beetle and a locust, but is utterly indifferent as to his knowledge of the botanical differences between the sál and the teak.

In Europe, where there are only a few well-known types of forest trees, an acquaintance with systematic botany is of minor importance to the forester, but in India, where *there are such* an enormous number of different trees and shrubs, surely this can no longer be the case. To an individual who knows nothing about this branch of botany, an ordinary Indian jungle must appear as merely a chaotic mass of vegetation, and I for one fail to see how any one can rightly comprehend the relations which exist between its numerous component species or develop in his mind any order out of this chaos, unless he knows a little about the rudiments of botanical classification.

I would also ask how, without such a knowledge, he can possibly follow in an intelligent manner many of *the other lectures* given at the School. In the lectures on Forestry and Physiological Botany, allusions to Dicotyledons, Monocotyledons, Conifers, Acacias, Albizzias, Terminalias, Eugenias, Rubiaceæ, and so forth, must, of necessity, be of frequent occurrence. How can the student be possibly expected to know what such names mean, unless he receives some instruction in their botanical characteristics, for until he does so, they remain simply as so many mere words, which he learns by heart without being capable of attaching any definite meaning to them.

* Our correspondent is mistaken in saying that Systematic Botany is not still to be taught to Rangers. The subject is taught as usual to the whole Rangers' Class, but it will not be a compulsory subject in the examination for the Rangers' certificate, except for honour men.—[ED.]

In Europe there are well-known names for each important species, and full accounts of them are given in popular works, but in India the language varies in each province, and in the same tongue there are frequently half-a-dozen or more names for the same species, so that it is impossible to employ any vernacular names for the purposes of instruction. The past history of forest literature in India proves also how great is the necessity for this study, for amongst the first and most important publications we find such works as the Forest Floras of North and Central India, of Madras, of Burma, of the Punjab, the Manual of Indian Timbers, and others which cannot be properly utilised by persons unacquainted with Systematic Botany.

The students are to be taught all about the minute structure of plants, rejuvenescence, conjugation, multiplication of cells, vacuoles, spiral, annular, reticulate, dotted, pitted, scalariform, iso-diametric, sclerotic cells, schizogenetic, lysigenetic or rhexigenetic chambers, and I know not what besides; and yet, although they are supposed to comprehend all these things, they are either considered incapable of mastering the rudiments of botanical nomenclature, and of learning anything about the simple shapes of leaves, the different forms of fruits and flowers, or such knowledge is regarded as useless.

Last October an important Forest Conference was held at Dehra, one of its objects being to discuss the system of training at the Forest School, but the subject of making Systematic Botany optional, was not, as far as I am aware, even mooted; now if it was contemplated to make this alteration in the training, does it not seem regretable that the opinions of the members of the Conference were not obtained on the point.

I am far from wishing to underrate the importance either of Physiological Botany or of Entomology. The former is undoubtedly the most scientific branch of Botany, and its development is of the greatest moment, but it is still in its infancy, and as yet consists largely of theories which are subject to constant changes, witness the alterations in the two editions of the text-book by Sachs. Entomology in India is also as yet a comparatively unknown science, and although it is highly desirable to encourage its study, yet it must be most difficult to impart practical instruction in it to Rangers.

In conclusion, I would ask those Foresters who believe in Rangers acquiring an elementary botanical knowledge of the trees amongst which they are to pass their lives, to express their opinions on the subject in the pages of the "Indian Forester."

TAU-THA.

NEW ENTRIES AT FOREST SCHOOL, DEHRA DUN.

An entrance examination to test the capabilities of the new students for the Rangers' class at the Forest School in English

and Mathematics was held on the 2nd July, with the following results—

36 students presented themselves, 21 being Government students, 2 from Patiála State and 13 private.

Of the latter the following were admitted :—

Mr. Calderwood.
 „ Haldane.
 „ Haslett.
 „ Hobday.
 „ Litchfield.
 „ Powell.
Lala Punna Lal.
 „ Gulab Rai.

The two latter did not wish to join the school as private students, but are qualified for admission as Government students in case vacancies occur in any circle.

Besides the above, there are 6 new students for the Foresters' class, and 31 senior students of the Rangers' and Foresters' classes, bringing up the number at the School to 66 altogether.

A further examination was held in Mathematics and Physics in accordance with Forest Department Code, Section 38 (iii), at which Mr. Calderwood passed creditably.

We regret to state that for the last six weeks cholera has been prevalent in the Dehra Dún district, and that Babu Devijabar Chatterji, Forest Ranger from Assam, who was studying in the Rangers' Class, as well as his servant, succumbed after a few hours' illness. The late Babu was a general favorite at the School for his amiability, and his activity in forest work, and intelligence, promised well for his career, which has unhappily ended in such an untimely manner. In order to prevent crowding, the Vernacular Class has been dismissed, but happily there have been no more cases amongst the Rangers' Class, which is continuing work as usual, at the School.

COMPOUNDING FOREST OFFENCES.

To continue some further remarks on this subject which appeared in the July Number, Section 67 is one of the most useful in the Forest Act, and without it forest work would more or less—rather more perhaps—come to a standstill, and Government would be a loser in revenue as well as in the protection of its forests. I allude to the largely scattered deciduous forests. On an average a forest guard or chaprassie has 10 square miles of forest (*often* scattered and in patches) to patrol and guard, and the *great majority* of offences are very petty, such as taking a head-load of grass or fuel without a license, or bringing a few rafters in a cart load of grass, &c., &c.; if for all such offences the forest official was obliged to take the cases into court, then his

beat would be left unguarded, which in the aggregate would amount to a very considerable part of each month; also the trials of such petty cases are not only tedious, but conviction is very uncertain, for as a rule the Forest guard is the sole witness; and also the people concerned willingly pay double or treble the ordinary rates as compensation in preference.

Similarly as regards grazing, if the guard had to be absent a week or two each month, prosecuting these small cases, the villagers would indulge with impunity in illicit grazing during such period. Therefore it behoves our Inspector-General to watch jealously this Section 67, and see that its provisions are in no way curtailed, for in these days of Public Service and Finance Commissions there is not much likelihood of obtaining an increase to the present weak and inadequate protective establishment.

14th July, 1887. A. J. C.

RECORDING EVIDENCE IN FOREST OFFENCES.

SUB-ASSISTANT Conservators of Forests of Bombay are authorized (G. R. 3487 of 30th April, 1884) to exercise power under Section 71, *a*, *b*, *c*, *d* of the Indian Forest Act, 1878, that is, they can record evidence while investigating a forest offence. Under Oaths Act, Section 4, whoever is legally authorized to record evidence, is authorized to administer oath. Evidence Act I., Section 3, says, whoever is authorized to record evidence on oath forms a court, Sub-Assistants therefore form a court. Criminal Procedure, Section 480, rules, that a court can take cognisance of the offences under Sections 178, 179, 180, and 228 of the Indian Penal Code. Sub-Assistants therefore are competent to take cognisance of the said offences. "P. R. D." in "Bombay Gazette" of 21st July, 1886, also holds the same opinion. Now the questions are should Forest officers' courts be considered a Revenue, Judicial or a Criminal *court, and to whom does the appeal from such courts lie?* The punishment for the said offences is six months' simple imprisonment, or Rs. 1,000 fine; if the fine is paid, of course it is to be easily credited to Government under the proper head, but if the accused declines to pay the fine, what procedure is to be followed to send him to jail?

Bombay, S. C. DIFFICULTY.

COMPOUNDING FOREST OFFENCES.

IN answering the question put by "Q" in page 323 of the July Number, I am of opinion that, according to Section 25 *c*,

carrying fire in the reserve forest, closed to fire, is a forest offence, and in Section 67, Forest officers empowered under Section 67 can compound it. Compounding an offence means the acquittal of the accused (Criminal Procedure, Section 345), so the money taken by way of compensation is only for the damage done and can not amount to fine. If the damage done is nothing, the compensation for the same must be nothing too, so the Forest officer must either release the accused taking nothing from him, or must prosecute him.

BOMBAY, S. C., *13th July, 1887.* H.

WATER-SPOUT AT JALPAIGURI.

We give the following account of a water-spout at Jalpaiguri in Bengal, in June, from a private letter:—

"Last evening there was a water-spout over the Teesta river. Clouds were revolving very fast, and we saw the water rushing up in the centre, and when the water-spout worked its way on to land just over the police lines, it tore a lot of thatch off the roof of the police hospital, knocked down the mat walls, and carried two men out of the hospital and blew them about 200 feet away! We were watching the water-spout, it made a tremendous noise when it touched the police hospital, and it carried the straw as far as our house and showered it down here. It was a grand sight."

LENGTH OF TIGERS.

REPLYING to "D's" request for reliable information on this subject, the two largest tigers measured by me during the past 13 years in these provinces, were 10 feet 2 inches and 10 feet 3 inches long. Both were old males in very high condition from feeding on cattle, and each succumbed to one bullet, as is frequently the case with heavy old tigers.

I have measured several tigers between 9 feet 6 inches and 10 feet in length, but should say that 9 feet 3 inches was about the average for a full grown well fed young male.

N.-W. PROVINCES, *July 1887.* S. E.-W.

III. Notes, Queries and Extracts.

The Agricultural Pests of India.*—Considerable attention has been directed lately to agricultural pests of all kinds, and especially to insect pests, in various countries, because the injuries occasioned to crops by their agency have greatly increased, and in some instances altogether new disorders and diseases attributable to them have appeared. The universal international exchange of agricultural produce and other commodities has tended and must tend to distribute insects, fungi, and other sources of evil to mankind, animals, and plants, throughout the world. Thus the terrible scourge of the vine, the *Phylloxera vastatrix*, was first introduced into the French vineyards with plants, or cuttings, of vines imported from the United States. Very many insects most noxious to agricultural, fruit, and garden crops, in the United States were brought there with plants, cuttings, fruits, and seeds. The elm-leaf beetle, *Galeruca xanthomelæma*, which is now seriously damaging elm trees, was not known in the United States until 1837, and came probably from France, or Germany, where it had been a troublesome pest long before that date. The hop fly, *Aphis humuli*, called the "barometer of poverty" by a Kentish historian of hop culture, has only recently visited the hop plantations of America; yet it caused almost a total blight last year in those of the Eastern States, upon an area of nearly 40,000 acres. Without any doubt this insect was conveyed from England in "hop-sets." The Hessian fly has been conveyed to Great Britain by some means or other not yet discovered, during the last year, and bids fair to be a dangerous and permanent scourge to the wheat and oat crops of this country.

It is the same with moulds, or mildews, or "blights," occasioned by fungi. The vine mildew, *Oidium tuckerii*, was not dreamed of in France until 1845. The potato mould, *Peronospora infestans*, had shown no important sign in Great Britain until 1844. The coffee mildew, *Hemileia vastatrix*, did no serious harm in the coffee plantations of Ceylon until after 1870; but during the last ten years it has enormously decreased their yield

* The Agricultural Pests of India and of Eastern and Southern Asia, Vegetable and Animal, Injurious to Man and his Products. By Surgeon-General Edward Balfour, Author of "The Cyclopædia of India," &c. (London: Bernard Quaritch, 1887).

Diseases of animals have also been greatly intensified during the past thirty years in Great Britain and in other countries. In India, as we gather from this little book of Surgeon-General Balfour, anthrax, pleuro-pneumonia, rinderpest, foot-and-mouth disease, are so rampant that the Madras Government has recently appointed an inspector of cattle diseases with a sufficient staff under him.

There is no doubt that the attacks of certain insects and parasitic fungi are more frequent and more fatal than formerly. Hop blights from aphides and mildew, *Spærotheca castanei*, are far more common and destructive in England than they were fifty years back; and the orange growers of Florida, California, and other places where oranges are cultivated, are at their wits' end to combat the ravages of scale insects, Coccidæ, which have greatly increased since 1870.

It is a moot point as to whether this is due, or not, to modern and more artificial systems of cultivation, which may be more favourable to the spread of insects and parasitic fungi. Or it may be that these new systems interfere with the balance of Nature by decreasing parasitic and other insects, and birds and other animals, which are the natural foes of injurious insects. It has been discovered by Prof. Forbes, of Illinois, that several species of the Carabidæ and Coccinellidæ eat the spores of fungi; therefore an unusual increase in the number of birds, or other foes of these insects, might occasion a serious spread of mildews.

The importance of the subject of agricultural pests cannot be overrated. It is now fully recognized by the Government of the United States, who have a distinguished entomologist upon the staff of the National Agricultural Department. Besides this, many of the States have their own entomologists, who furnish frequent and valuable reports and advice as to methods of treatment. In England the Agricultural Department of the Privy Council have lately issued a series of reports upon insects injurious to crops, written by Mr. Charles Whitehead; and Miss Ormerod, the entomologist of the Royal Agricultural Society, has published annual reports for upwards of ten years, which have been of the utmost value and practical benefit to agriculturists. And in India, as Surgeon-General Balfour tells us in this work, the serious injuries caused by insects and other animals, fungi, and bacilli, to mankind, animals, and plants, have at last attracted the attention of the Government of India, and it is proposed to invite communications from those engaged in agriculture, forestry, and horticulture in that country, to furnish matter for periodical reports like those issued from time to time by Miss Ormerod. These would of course be published in the vernacular, and should be illustrated by woodcuts, as Miss Ormerod suggests in her comprehensive letter in the preface of "*Agricultural Pests of India*." It is much to be hoped

that a competent entomologist may be appointed in India to direct this work.

Surgeon-General Balfour, so far back as 1880, recommended the Secretary of State for India to obtain reports on the diseases of cattle and plants, and on creatures noxious to mankind and vegetation. In his admirable "Cyclopædia of India and of Eastern and Southern Asia," published in 1885, he gave a general view of the entomology of these regions, and described the losses sustained by agriculturists from these and similar causes. He has followed this up with the work now under review.

Though a small book, the "Agricultural Pests of India" is very ambitious in design, as it treats not only of insects and fungi and animals injurious to mankind and agricultural crops, but of all manner of birds, beasts, and fishes. Several of these cannot, even by the greatest stretch of the imagination, be classified as pests to agriculture, and seem to be altogether out of place in this category. Under the heading "Fish," sharks and siluroids are described, though it is not by any means clear in what way they are agricultural pests, except, perhaps, that they might bite off the limbs of unwary agriculturists disporting in the sea. The book should have been styled the "Natural History of India," or "A Manual of the Natural History of India," rather than the "Agricultural Pests of India." But the fact that rather too many subjects are dealt with cannot be held to be a very serious fault in a compilation containing an immense amount of serviceable information arranged alphabetically, together with a good index, so that any head can be quickly found. The author had great opportunities of acquiring knowledge of the branches of natural history he has here discussed while he was engaged in forming the Government Central Museum at Madras, and other museums in various parts of India, as well as in the preparation of "The Cyclopædia of India" and his work on "The Timber Trees of India." He was therefore very well qualified to prepare this manual or dictionary of natural history, which will serve to show Indian agriculturists what are the principal foes of their crops and herds. No remedies or methods of prevention are given in detail. Some general instructions appear in the introductory chapters, such as to farm cleanly, and to use certain washes and powders in case of the attack of some insects. These, however, have evidently been taken from lists of remedies prescribed by American and English practical entomologists, and have not been actually tried in India. Now that Surgeon-General Balfour has demonstrated the dangers, and indicated general remedies which have been found advantageous in other climes, the farmers, the foresters, and fruit-growers of India should at once make experiments, and prove for themselves whether these are as efficacious in the fiery heat of the East as in the temperate climates of Great Britain and America.

This notice cannot be concluded without an allusion to some of the errors which have been carelessly allowed to remain in the book, having evidently escaped the notice of the eminent scientific man who "revised nearly the whole in manuscript, and the proofs as they passed through the press." It is not to be expected that Surgeon-General Balfour should be a skilled entomologist, but it is very unfortunate for him that those on whom he relied for assistance should have so signally failed him. He says that the *Cecidomyia tritici* is the Hessian fly of Europe and America. In reality the Hessian fly of Europe and America is *Cecidomyia destructor*, named so by Say long ago, and is completely and specifically distinct from *Cecidomyia tritici*, which is the true wheat midge of Great Britain. This is a mistake which appears unpardonable in a scientific reviser. On p. 45 it is stated that "the species of Necrophorus and Silpha are useful; they feed on carrion, and by scratching the ground from under dead animals they partially bury them." As a fact the *Silpha opaca*, and another species, the *Silpha atrata*, eat and seriously injure plants of beet and mangelwurzel, as has been shown by Curtis and Miss Ormerod in England, by Guérin Méneville in France, and Taschenberg in Germany. It need hardly be said that correct information as to the habits of insects is as necessary as accurate nomenclature—at least to agriculturists.

Again, under the heading Buprestidæ and Elateridæ (click beetles) it is remarked that the larvæ feed on living wood, and are more or less injurious. The wire-worm, the larva of *Elater lineatus*, is fearfully destructive to the roots of crops of all kinds. In the description of Elateridæ, further on, this kind of mischief is attributed to their larvæ; so that there are two utterly conflicting accounts of the habits of these insects, calculated to puzzle the inquiring Indian farmers.

A sweeping statement that "all the weevil family insert their eggs in the stigma of the flower" cannot be supported, and is utterly opposed to the experience of observers. A few species do this, but others deposit their eggs in a variety of places. Of weevils it is also said that they "attack principally in their larval stage every part of vegetable tissues." As a fact, many weevils do incredible harm to vegetation in their perfect or weevil form, and it would be difficult for the larvæ—mere maggots—to hold on to leaves.

Sitonas, described as attacking stored grain and seed, have been evidently mistaken for species of Bruchi.

These and other mistakes ought to be corrected before the work is put into the hands of the agriculturists of India as a text-book for their guidance.—*Nature.*

THE AGRICULTURAL PESTS OF INDIA.—We have received from Surgeon-General Edward Balfour a small volume entitled "The Agricultural Pests of India, and of Eastern and Southern Asia, Vegetable and Animal." He gives, in his introductory remarks, the aim of this work as, "to make these enemies to man known, and to indicate measures likely to check their ravages."

Now this we consider a very desirable object, and we quite agree with the author, who says as his beginning that "agricultural pests are the foes of man," but he certainly has an original idea of what these pests consist of, and they must have a very extended range when he includes amongst them such animals as elephants, tigers, snakes, and fish (of sorts, sharks particularly). That these are also the "foes of man" in a sense we know, but we should hardly of ourselves have put them in the same category as he does. Why does he not include diseases, such as cholera, small-pox, &c., and last, but not least, why does he exclude the "mahajun?"

The few hints that he gives as to cleanly cultivation, &c., and the information that he has collated in his alphabetical list, may certainly be of interest or of use to the Europeans in the country, but these hardly constitute the agricultural population of it, and we fail to see how the book is, in any way, to benefit the ryots, or how he (the author) proposes to communicate the necessary information to them, unless his intention is to induce the Government to institute a special department for the investigation of agricultural pests, and the instruction of the natives of the country in methods for their obviation and extirpation.

We learn from Dr. Balfour that some steps towards the investigation of a few of these pests have already been initiated, and he speaks of reports as "coming in;" what shape these reports may have taken we do not know, but it seems to us, that, unless they are sent in by competent scientific men, they must be accompanied by properly preserved *specimens* of the particular pest (in all its stages) infesting the region, to be of any use in studying the life-history and conditions of existence of the insect or plant referred to, which is the first step towards staying the progress of the blight, whatever it may be, and we do not find any suggestion to this effect.

We believe that a somewhat exhaustive enquiry was once held into the tea blight in Assam, and that one is now being prosecuted into the diseases, &c., of silkworms; but if a regular establishment can be kept up at *some* considerable cost to Government for the exploration and preservation of archæological remains, which, though of great historical value, are not, at all events, of any *vital* interest to the masses of the population, we certainly think that money should not be spared to investigate in a proper manner the "agricultural pests" which *are* of vital importance to them, and not only to them, but, to judge from the statistics of Dr. Balfour, to the Government itself in the matter of revenue. We do not ourselves propose to enter into

this matter of statistics, but if it is true, as stated, that annually one-quarter of the cotton crop is lost by insect ravages, what must be the deficit to the revenue were the wheat, rice, &c., added to the return?

The first duty of a Government is, we take it, to attend to the interests of its subjects, the largest class of these in India being, we believe, that of cultivators in various forms; and to judge from the book before us the claims of this class seem to have been very much neglected, in at least the one direction pointed out by it, and we only hope that this little volume will have the effect of stimulating the Indian Government to more active measures in this regard than it has hitherto taken.—*Asian.*

FUNGI ON TEA ROOTS.—The following letter from Mr. Grant, Manager, New Cinnatolliah Tea Co., Limited, North Lakhimpur, Assam, in reference to a notice which appeared in the Proceedings of the Society for March, will be read with interest by Tea Planters:—

I have noted in the Proceedings of the Agri. and Horticultural Society of 23rd March last, some remarks about fungi on roots of tea-bushes. Finding no allusion to certain kinds of tree roots killing the tea bushes round them, I take the liberty to inform you for the benefit of others, that the roots of the *Súm* (on the leaves of which the Assam Múga silk-worm is fed) and *Búkain*, a kind of pariah ním, unless removed when a clearance is made for planting tea, always destroys the tea planted round the stumps, and unless the root is *entirely* (including laterals) removed, it will be difficult to get tea to grow near it for years. I myself have seen numbers of instances; in some places the tea-bushes were destroyed within a radius of 15 feet from the stump. Though there are other tree roots that have the same effect, the above two hardly ever fail when the tree is cut and the root left in the ground to decay, otherwise if left growing, they do not seem to effect the tea bushes. The only way is to remove the stump entirely and replant the spot, sacrificing even a few bushes, as they will invariably die in time if the roots are not entirely dug out.

The subject being of some importance to Tea Planters, Dr. King was consulted, and the following is his reply:—

An analysis of the wood of the two trees you mention would not, in my opinion, be of any use. If experience shows that the wood of these is especially affected by this dangerous fungus, all stumps of these species should be up-rooted. But I do not think that by an analysis of their wood, we should learn the cause why the fungus prefers them. If the dead stump cannot be actually dug out from gardens where they have been left, they might be isolated by digging a trench round them, so as to prevent the spread of the fungus from them to the surrounding tea-bushes.—*Agri. and Horticultural Society of Madras.*

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FORESTRY IN FRANCE.

(*Continued from page* 355).

Two variations of simple coppice are sometimes practised :— (*First*), That known in the Ardennes as *sartage*, in which, after the wood has been cut and removed, the twigs and chips are burnt on the ground, in order that their ashes may afford sufficient manure to raise a crop of cereals, during the year immediately following the cutting. This system, which, as carried out in France, seems to be practised rather for the sake of obtaining a crop of corn than as a method of forest culture, is gradually dying out. It is not adopted in the areas under the State Forest Department. (*Second*), That known as *furetage*, in which, instead of clean-cutting the coppice, those shoots only are taken, which have attained certain fixed dimensions, the operation being repeated annually, or after intervals varying from two to five years. *Furetage* prevails chiefly in the valley of the Seine, in the forests whence the fuel-supply of Paris is drawn ; but it is also employed in the mountainous districts of the south, in forests maintained for the protection of steep slopes, which it is undesirable to completely denude.

It is impossible here to enter into anything like full details regarding these sylvicultural questions. To study them completely, as they are taught and practised in France, reference must be made to the books on the subject, among which may be mentioned "The Manual of Sylviculture," by G. Bagneris (translated into English by Messrs. Fernandez and Smythies), Rider and Son, London ; and "*Le traitement des bois en France*," by C. Broillard, Berger-Levrault, Paris.

Working Plans.

Working plans or schemes will, in course of time, be prepared for all forests administered by the Forest Department. The law provides that all these forests shall be subject to the provisions of such plans ; and that no fellings not provided for therein, and no extraordinary cuttings, either from the communal "reserve," or the blocks destined to grow from coppice to high-

forest, shall be made, without the express sanction, in each case, of the Government, by whom all plans must be approved before they can be adopted.

Subject to due provision being made for the exercise of rights of user, the working plan provides for the management of the forest, in the way that will best serve the interests of the proprietor. Unlike an agricultural crop, which ripens and is gathered annually, trees take many years to grow to a marketable size, the actual period they require being dependent, not only on their species, and the natural conditions under which they are grown—climate, soil, and so forth—but also on the use to which they are to be put. Thus a coppice, being required to yield wood of small size only, may be cut every twenty-five to forty years; whereas a high-forest, which is destined to produce large timber, must stand for a much longer time. It would be excessively inconvenient if the entire crop of such a forest were felled only once in every 100 or 150 years; and it is chiefly to avoid this that a working plan is required, which prescribes the arrangement necessary in order to allow of the produce being taken out annually, without intermission and in equal quantities, so that a regular and sustained income may be drawn from the forest. For example, a simple coppice thirty acres in extent, of which the crop is to be felled at the age of thirty years, might either be entirely cut down at one time, and then allowed to grow up again for thirty years; or—a much more convenient arrangement—it might be divided into thirty one-acre compartments, each of which is to be felled in succession, so that by taking one plot each year, the whole area would be worked over in thirty years. The working plan must then, in the first place, prescribe the age at which the trees are to be felled, with reference to the average number of years that they take to arrive at maturity, or to attain the required size; and it must then fix the yield, or the amount of wood to be annually removed, this quantity being expressed either in the form of an area to be cut over, or a number of cubic feet of wood to be taken out. But in the case of a high-forest managed under the selection method, it is sufficient to fix the number of trees of a minimum size to be cut out annually.

The provisions of a working plan vary according to the nature of the forest to which it relates. In the case of the simple coppice instanced above, the first thing to do would be to obtain a map (*see Plate, Fig.* 1) showing the principal features of the ground, such as the edge of the plateau, the stream, and the road. The area would then be broken up, for purposes of examination and description, into temporary plots, such as those lettered from (A) to (H), each plot comprising a portion of forest more or less homogeneous in its composition. This study of the crop would enable the area to be divided into the thirty permanent one-acre compartments above alluded to, and it would

also determine the order in which they should be numbered, so that the older portions might be cut first. It is evident that if one of these be cut every year, the series of compartments will, after the lapse of thirty years, contain forest of all ages from one to thirty years; and if the annual felling be invariably made in the oldest compartment, it is obvious that the age of the crop cut will always be thirty years.

To make a working plan for a regular high-forest, to be treated by successive thinnings, is not quite such a simple matter. If the forest be of great extent, it is, first of all, divided into two or more *series* or working-circles, each of which is dealt with separately. After the examination and description of the temporary plots, the working-circle (*see Plate, Fig.* 2) is divided into a number of equal blocks, called *affectations;* and when the ground has once been completely worked over, the crop *on each of these will always be, within certain limits, in the* same stage of development, and subjected to the same kind of treatment. Thus, if the trees are to be felled at the age of 120 years, and there are six blocks, the sixth may contain the young growth, aged from 1 to 20 years, the fifth young poles from 21 to 40 years old, and so on, the first containing the old trees which are to be felled. The blocks having been formed, each of them is then subdivided into compartments, usually corresponding in number with the years over which the fellings within it are spread (twenty in this case); and, while the trees are being cut in the first block, cleanings and thinnings, of various recognised degrees, are going on in the compartments of the others, until each, in its turn, arrives at the age at which the trees are to be removed. It is clear that, in this case also, the forest will ultimately contain a due proportion of trees of all ages from 1 to 120 years, which is an essential condition for its regular management. The working plan prescribes the order in which all this is to be done, and lays down the number of cubic feet of timber of the oldest class to be taken out annually from the first or oldest compartment, so that the entire stock on *it may be removed within the first period of twenty years;* wind-falls and dead or dying trees are always taken first. Each of the remaining compartments is similarly dealt with when its turn to be felled arrives. The quantity of wood to be removed by thinnings cannot be prescribed by the working plan, as they must be made to the extent judged necessary to develop the trees which are left. The forester's art is to do this skilfully, and ultimately to remove the old trees in such a manner, that they may leave behind them a young self-sown crop to take their place; and so on throughout successive generations.

For a high-forest to be managed under the selection method, the arrangement is different. Here it is, of course, equally necessary that all the age-classes should be represented in due proportion; but instead of the trees or poles of each class being

grouped together in separate compartments, all classes are mixed indiscriminately over the entire area of the forest, and there is no necessity for the formation of *affectations*, or compartments, of the kind just described. Take for instance the mountain forest sketched in the plate, *Fig.* 3. After the main features, such as the streams, ridges, and roads, have been laid down on the map, the temporary plots, and the descriptions of them, are made as before. The forest might, in the present case, be divided into three sections, the upper of which, being on the crest of the hill, is required to be kept as dense as possible, and will not be dealt with in the working plan, for dead or dying trees alone will be removed from it. Suppose that the annual yield of the central section, which is 150 acres in extent, has been fixed, with reference to the estimated rate of growth and degree of completeness of the stock, at 50 cubic feet per acre, and that trees of marketable girth within it contain, on an average, 100 cubic feet of timber; it follows that the number of such trees which may be removed annually from the section is $\frac{150 \text{ by } 50}{100} = 75$. Theoretically, this number should be taken, one here and one there, over the whole area. But this would be very inconvenient; so the forest is divided into twelve or any other convenient number of equal or nearly equal blocks, from each of which, in succession, the entire number of trees is cut; after taking windfalls, the choice falls on the ripest trees, those which are dead or dying being selected first. The section below the road is in another zone of vegetation; it is 100 acres in extent, and its annual yield is calculated at 60 cubic feet per acre. Suppose, then, that trees of marketable girth in it contain, on an average, 110 cubic feet of timber, the number of such trees to be cut annually is $\frac{100 \text{ by } 60}{110} = 54$. The section will then be divided into blocks,—in the instance illustrated by the map the number is ten,—from each of which, in succession, the entire number of trees is taken. In this manner, each zone of altitude may be dealt with on its own merits; while, at the same time, the annual fellings, being localised, are easy to supervise, and the wood can be disposed of more readily and more profitably than if the trees had been felled, here and there, over the entire area.

The working plan for a forest under conversion would, of course, differ from any of the above; but this somewhat complicated question will not be dealt with here.

It is only by an arrangement similar to one of those above briefly sketched, that the permanent annual yield of a particular class of produce can be assured, and that the forest can be secured against risk of gradual extinction.

A special branch of the Forest Department is charged with the preparation of working plans, which are not made by the

local officers, except in the case of small forests, the plans for which they can frame, without interference with their ordinary duties; but they undertake the revisions, which are made every ten or fifteen years, in order to guard against errors, and to allow for changes in the rate of growth, or other causes of disturbance. Pending the preparation of such regular plans, the Forest Department draws up provisional rules, which must accord with local usages, where these are not opposed to the recognised principles of sylviculture. Up to the beginning of 1877, regular working plans had been completed for more than two-thirds of the total area of the State forests, and for somewhat less than one-half of the communal forests. The work progresses more slowly in the latter than in the former, because, in their case, the funds have to be provided by the communes, and the money is not always available; but, as a matter of course, the most important forests were taken in hand first, and these have, for the most part, been completed.

The question of working plans has necessarily been here dealt with in an extremely superficial manner. In order to gain anything like a complete idea of the systems pursued in France, the following works should, among others, be studied, *viz.*: "*Aménagement des forêts,*" by C. Broillard, Berger-Levrault, Paris, 1878, and "*Aménagement des forêts,*" by A. Puton. A translation of the latter work has appeared in Vols. viii. and ix. of the "Indian Forester."

Products obtained from the Forests.

The yield in wood, of various classes, having once been fixed by the working plan, it is the business of the department to realise it, as nearly as circumstances will permit. As to tanning bark, all that the felled trees or poles will yield is utilised. Cork bark is taken from the living trees, which will not bear the removal of a too large proportion of their protective covering, and hence care has to be taken not to overwork them. Resin is collected on a large scale in forests of the cluster pine (*Pinus maritima*), which only yield it freely on the hot and damp coasts of the south-west.

The yield in minor produce, such as grass, moss, litter, and other things, being small, and details regarding it not being available, this class of products cannot receive more than a passing mention. Neither can account now be taken of the numerous advantages, which the forests undoubtedly render to the population, but which cannot be expressed in the bulk or weight of the products drawn from them.

The latest available statement of yield relates to 1876, in which year the State and communal forests, taken together, gave 5,620,663 loads (50 cubic feet) of wood, or an average of about 40 cubic feet per acre; also 50,742 tons of tanning bark, 292 tons of cork bark, and 1,967 tons of resin.

The yield in wood per acre of the State forests somewhat exceeded that of the communal forests ; but while, in explanation of this, it must be said that the greater extent to which grazing is practised in the latter, affects their wood production unfavourably, it must also be admitted that the large proportion of their produce, made over to the inhabitants for their own use, is estimated at a low figure, so as to reduce, as far as possible, the charges on account of management by the Forest Department ; and the apparent difference is largely due to the latter cause. Of the total yield in wood, 1,364,846 loads were timber, and 4,255,817 loads were firewood ; and, as might be expected from what has been said before, regarding the different systems of culture adopted, the State forests gave the larger proportion of timber, one-third of the wood from them being of that class ; while, in the communal forests, the proportion of timber was only one-fifth. A still more striking result would follow on a comparison of the nature of the produce obtained from the State and from private forests ; and, since timber is a more useful and valuable product than firewood, the advantage to the country, from this point of view, of considerable areas of forest land being owned by the State, is apparent ; the more so when it is remembered that France does not grow more than two-thirds of the amount of building-timber she consumes.

The communal high-forest is for the most part situated in the mountains, and is composed of coniferous trees ; this explains the fact that the greater part of the timber derived from the communal forests consists of fir and pine, whereas only about one-third of that coming from the State forests is of those kinds.

Sales and Export.

Principal Produce (Wood, Bark, and Resin).—With the exception of the produce made over to right-holders, and of that delivered to the inhabitants of the communes from their forests for their own consumption, as well as of comparatively small quantities of timber cut in the State forests for the War Department and Admiralty, the whole of the annual produce is sold by public auction, and no other mode of sale is permitted. There are three principal systems of disposal, *viz.*—(1*st*), sale of standing trees ; (2*nd*), sale at a rate per cubic metre, or other unit of the produce, cut, converted, and taken out by the purchaser ; and (3*rd*), sale of produce cut and converted by departmental agency. The first of these systems necessitates a previous marking, either of the trees which are to be removed, or of those which are to be reserved ; there is no guarantee given either as to the number of trees, or as to their species, size, age, or condition ; they are bought and sold on the best estimate

that either party can make of their value as they stand. The purchaser, as a matter of course, cuts up and exports the wood at his own cost, and in the form which best suits him, being bound, under severe penalties, to carry out this work, in the manner prescribed by the conditions of sale. It has been urged that this system needlessly introduces a middle man between the producer and the consumer, and that thus the profits of the former are reduced, while the regeneration of the forest may be compromised, by felling and exporting the trees in a careless or ignorant manner; but in reply to this, it may be said that the wood-merchant must always exist, as it is but rarely that the actual consumer can himself go to the forest to get what he wants; and that, by strictly enforcing the conditions of sale, which are framed with special regard to this object, interference with the regeneration of the forest is practically avoided.

The second method differs from the first, only in that the auction-sale determines merely the *rate* at which each of the various classes of produce is to be paid for; but it is open to the objection that the classification of the produce is difficult, and it thus leads to frequent disputes, in the settlement of which the interests of the proprietor (State or commune) may be allowed to suffer. This method is rarely adopted, except in the case of thinnings, when the quantity of wood cannot well be accurately estimated beforehand.

The sale of timber, cut and fashioned by departmental agency, is rarely resorted to; it has, certainly, the advantage that the work is better done, and that more complete precautions can be taken to secure the regeneration of the forest; but, on the other hand, the State, or the commune, as the case may be, must advance all the money for the work, and the Forest officers become charged with a large amount of supervision and accounts, while a number of purchasers are admitted to the forest, and offences of various kinds are from time to time committed by them. But the chief objection to the system is, that the wood is not always cut up in the manner which best suits the requirements of the market at the moment, a matter with which the Forest officer can never be so well acquainted as the professional timber-merchant; and thus, not only do the general interests of the country suffer, by failure to supply wood in the form most required by the consumers, but the prices realised are not always so good as those which the produce might have been made to fetch, had it been cut up in some other manner.

Timber sold standing usually commands a higher rate than it does when disposed of in any other manner; and for this, in addition to the other reasons that have been given, the first of the three systems is the one generally adopted, in both the State and the communal forests. This method of sale is not generally followed in other European countries; but the French system, which has stood the test of experience, is greatly facilitated by

the honesty prevailing, as a general rule, in the trade to which it has given rise.

In consequence of the absence or insufficiency of export roads in Corsica, and of the difficulty experienced in getting purchasers, willing to take the produce for a single year only, a law was passed, in 1840, which enacted that the timber to be cut in any part of that island, during a series of years not exceeding twenty, might be sold, at one time, to a single purchaser, the State, at the expiry of the term, becoming possessed of all works erected by him, without liability to the payment of compensation for them. A few of such contracts exist to the present day; but both the system of roads and the timber trade having largely developed, during the last forty-five years, the practice of entering upon such engagements is gradually dying out.

Minor Produce.—Receipts on account of minor produce form an insignificant portion of the gross revenue derived from the French forests, the most important item being that relating to the sale of hunting and shooting permits. Minor produce is not sold so much as a source of revenue, as to enable the agricultural population to make use of it, without giving rise to the idea that they are entitled to it by right. It is sold by private contract, the price being fixed by the Conservator, or by the Prefect or Mayor, in the case of the State and communal forests respectively. The conditions under which such sales are effected in the State forests, are determined by each Conservator, with reference to local circumstances; and he also retains the power to forbid the sale, from the communal forests, of any classes of produce, the removal of which would, in his opinion, be detrimental from a cultural point of view. Payment for minor produce is often accepted, especially by the communes, in the form of days' work done in the forest.

Wood supplied to the Admiralty.—Every year, a notice is sent by the Forest Department to the Admiralty, showing the localities in which trees, suitable for naval purposes, are to be felled; the latter Department then notifies the number and description of those which it desires to have reserved in each forest. The purchaser of the timber, sold from these blocks, fells, barks, and conveys the trees, marked for the above purpose, to an appointed place in the forest, where they are inspected and taken over by the Admiralty officials, who cut from them what they want, the rest of the wood being sold by the Forest Department, in the ordinary manner. The Forest officer and the marine engineer then agree upon the sum to be paid as the price of the wood removed, and as compensation, to cover losses caused by the depreciation in value of that rejected; the account is subsequently adjusted in the Financial Department. Up to the year 1837, the Admiralty had the right to select trees everywhere, including the private forests; but the system was not found to

answer, and it was abandoned in that year. Even under existing regulations, a very small proportion of the wood used by the Admiralty is obtained directly from the forests, the greater part of it being bought in the open market.

Wood supplied to the War Department.—The requirements of the War Department are met, as far as possible, from the State forests, the trees being marked and felled by the Forest Department, and removed, either directly by the military authorities, or by the Forest Department at their cost. The account is adjusted in the Financial Department. But the amount of wood so supplied is very small, as, except in cases where the State forests lie near fortifications or garrison towns, it is found more convenient and cheaper to purchase what is required in the market.

Roads and Buildings.

Without roads, which are required to render the forests accessible, and to facilitate the export of produce, this form of the natural riches of a country cannot be utilised; the construction of good export roads being one of the most effectual means of raising the forest revenue. Thus, in Corsica, where, before 1850, the State forests did not produce more than £200 a year, the annual revenue derived from them was raised, in 1868, to £8,000, the improvement being due, almost entirely, to the development of communications. At the end of 1867, there were 2,440 miles of metalled, and 5,380 miles of unmetalled, roads in the State forests of France, and since that year their length has been at least doubled.

The great importance of accommodating the forest guards, in suitable houses, within the forests, is fully recognised; and out of 3,200 guards, 1,400 are lodged in 1,213 houses, the remainder of them being granted allowances to lodge themselves in neighbouring villages. The proportion of roads and buildings, found in the communal forests, is much less than that in the State forests; partly because the communes have to pay for their construction, and funds are not always available, but partly also because the average size of these forests being smaller, roads and guards' houses within them are not needed to the same extent.

At the end of 1867 there were 126 saw-mills in the State forests, all worked by water-power.

Timber-slides, sledge-roads, wire-rope tramways, and such-like means of exporting wood, are very little used in France; they are to be found only in a few localities where the conditions are exceptional. A great deal of timber is required for their construction and maintenance; and, considering the price that wood of all kinds can command, it is found better and cheaper, even in mountainous regions, to make permanent roads, suitable for timber-carriages and carts.

Portable iron tramways have not yet come into general use,

as a means of exporting timber from the forests. It is believed that only one is in use in France at the present time, *viz.*, that at Baccarat, at the base of the Vosges; but the advantages, afforded by this means of transport, will doubtless shortly be better understood than at present, and a development of the system is to be anticipated—at any rate, in the forests of the plains. The floating of large timber is almost unknown; but firewood, for the supply of Paris, is still floated from the hills of the Morvan down to the railways.

Financial Results of Working.

The profit derivable from a forest is dependent on a number of causes, among which may be mentioned, the species of which the crop is composed, the depth and nature of the soil, the climate, the system of culture, the proximity to great centres of consumption of produce, and the existence of good lines of export.

Taking the average of the three last years for which the accounts have been audited, it is found that the receipts, expenditure, and surplus of the State forests were as follows, *viz.* :—

Revenue, .	£1,297,748 =	10*s.* 6*d.*	per acre.
Expenditure, .	571,347 =	4*s.* 7*d.*	"
Surplus, .	£726,401 =	5*s.* 11*d.*	"

But if the money spent on the afforestation of mountain slopes and *dunes*, and on the purchase of additional areas, be excluded, the expenditure on the existing forests is reduced to about £480,000 and the surplus is raised to 6*s.* 8*d.* per acre. The actual profit is indeed slightly more than this; for the figures include both expenditure *by the State* on the management of the communal forests, and the contributions paid by the communes on this account. The receipts are supposed to cover the payments, but they rarely do so, and some allowance must be made for this fact, when calculating the net profit derived from the State forests, which, during the years referred to, probably fell little short of 7*s.* an acre. Recent information relating to the receipts, expenditure, and surplus, resulting from the working of the communal forests, is not available.

The latest year for which full details, regarding the gross revenue per acre of the State and communal forests, are obtainable is 1876, when the figures were as follows, *viz.* :—

	State.		Communal.		Mean.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*
Principal produce (wood, bark, resin), .	12	6	7	5	10	0
Minor produce, ...	0	7	0	3	0	5
Total, . . .	13	1	7	8	10	5

The revenue from the State forests was then, in 1876, considerably higher than that above given, as the average of the last three years; and this was due to two causes, the first being the exceptionally large number of windfalls which occurred in that year, and the second the comparatively high rates then realised by timber. All but a small fraction of the revenue on principal produce, was obtained by the sale of wood and tanning bark; cork is produced solely in the forests near the Mediterranean and in Corsica, and resin almost exclusively on the shores of the south-west. The figures relating to State forests show the results of actual sales; but this is not so in the case of communal forests, as a large proportion of the produce from them is made over to the inhabitants for their own use, and its value is estimated at a low rate, in order to keep down the amount of their payment for the services of the State Forest Department; this contribution is levied in proportion to the sum of their gross revenue and the value of the wood delivered to them. Moreover, it should be said that the revenue on minor produce shows *cash* receipts only, no credit being taken for payments, made chiefly in the communes, by means of days' work done in the forests. These circumstances account, to some extent, for the smaller revenue obtained from the communal forests; but the true explanation is to be found in the important influence exercised by the system of culture adopted. In 1876, it was observed that the highest rate per acre of gross revenue was obtained from high-forest, and the lowest from simple coppice, while coppice with standards occupied an intermediate place. It was also found that, in the case of high-forest, the areas under coniferous trees yielded a much higher revenue than those under broad-leaved species, chiefly on account of the form of their stems, which enables a very large proportion of sawn timber to be obtained from them, but partly also from the greater value of the thinnings cut out during the early stages of their growth—in the form, for example, of telegraph-posts, hop-poles, &c. The revenue from forests composed of coniferous and broad-leaved trees, mixed together, lay between these two. But, of course, this is not an universal rule; for a high-forest of beech might yield a less return than a coppice with oak standards; and a similar comparison might be made between forests stocked with other trees of different relative values, and managed under various systems. The following figures, showing the results of sales in the Nancy Conservatorship, will serve to illustrate what has been said:—

Simple coppice, ...	yielded	4*s*. 4*d*.	per acre.
Coppice under standards, . . .	,,	11*s*. 8*d*.	,,
High-forest of broad-leaved species,	,,	13*s*. 1*d*.	,,
High-forest of coniferous and broad-leaved species, ...	,,	23*s*. 10*d*.	,,
High-forest of coniferous species, .	,,	51*s*. 6*d*.	,,

Looking, then, at the larger proportion of the communal forests kept under coppice, and at the relatively greater proportion of firewood and timber of small size they consequently produce, the smaller gross revenue per acre, they were able to yield, is no longer surprising. Taking the State and the communal forests together, it was found that their gross revenue was 22 per cent. per acre higher than that of the private forests, and this notwithstanding that these latter are, as a rule, on better soil, and are frequently grown under other more favourable natural conditions.

The average all-round rate, actually realised in the State forests, per load of wood of all sorts, including tanning bark, was 14*s.* 5*d.*; while that obtained in the communal forests was only 9*s.* 8*d.* The corresponding rate for the whole of the French forests, including those belonging to private proprietors, was 10*s.* 7*d.*; so that the rate in the State forests exceeded the general average by 37 per cent., while that in the communal forests fell to 9 per cent. below it.

It is not an easy matter to determine the capital value of a forest; but, in 1873, an estimate was made, which put that of the State forests at nearly 50½ million pounds sterling, which is equivalent to a little over £20 per acre. The gross revenue derived from them, in that year, represented a return of 3·15 per cent; but the net profit did not much exceed 2 per cent. on the estimated value. The capital value of the communal forests is certainly less per acre than that of the State forests, on account of the younger age at which the trees are, generally speaking, cut.

It has been estimated that the relative rates of interest on their capital value, paid by forests in which the main crop is removed at various ages, is something like the following, *viz.* :—

Age, . .	25 years, . .	4 per cent.
" . .	30 " . .	3½ "
" . .	40 " . .	3 "
" . .	60 " . .	2 "
" . .	100 " . .	1 "
" . .	200 " . .	½ "

These figures are intended to give a general idea of the manner in which, notwithstanding the increased value of the produce, the relative rate of interest declines, as the age to which the trees are left standing is prolonged. They have no claim to absolute accuracy, even as representing the average of French forests; and still less can they be assumed to apply to the forests of other countries. They serve, however, to explain what has been previously said, *viz.*, that on account of the higher rate of interest which coppice, generally speaking, yields, as well as for other reasons, it is a more suitable system for communes

than high-forest; and this remark applies with equal or even greater force to private forests.

Rights of User.

The principal rights of user are those relating to timber, firewood, and grazing; but there is also a small number of others, such, for example, as those which permit the cutting of turf, the collection of dead leaves, and the like injurious practices. In the State forests, the right-holders are, almost without exception, village communities; the instances in which private persons possess rights in them are extremely rare. The communal forests are, comparatively speaking, free from such burdens.

The law of 1827 provided for the investigation and disposal of all claims to the exercise of rights in the State forests, and barred the acquisition in them of any fresh ones. Hence those only have now to be dealt with, which have been formally admitted and recorded, in favour of the communities or persons who possess them.

The aim of the Department has always been to free the forests from such claims as far as possible; and the law provides for this being done in the following manner, *viz.*:—All rights of *wood* may be commuted, by surrendering possession of a portion of the forest itself in lieu of them, the terms being arranged by mutual consent, or, in case of disagreement, by the Courts; but the State alone can *demand* such a commutation, the right-holder cannot do so. Other rights, including those of pasture, cannot be got rid of in the above manner; but the State can buy them out, by the payment of a sum of money, the amount of which is settled either by mutual agreement or by the Courts. The sale of pasture rights cannot, however, be enforced in places where their exercise is absolutely necessary to the inhabitants, the question of such necessity being, in case of dispute, referred to the *Conseil de Préfecture*,* subject to an appeal to the *Conseil d'Etat*.† The law also provides, that the exercise of all rights not got rid of in either of the above ways, may be reduced by the Forest Department, with reference to the condition of the forests, and the mean annual production of the material in respect of which they exist; none can be exercised otherwise than in accordance with the provisions of the law and the rules based on it.

The principal features of the legislation regarding the exercise of wood-rights are the following *viz.*:—No wood can be taken, which has not been formally made over by the Forest Department; persons who possess a right to dead, fallen wood,

* An administrative tribunal, established in each Department of France.

† The central administrative tribunal, established at Paris, for hearing appeals from the decisions of the *Conseils de Préfecture*.

cannot employ hooks, or iron instruments of any sort, in its collection; when firewood is made over standing in the forest, it is felled, cut up, and taken out, by a contractor, selected and paid by the right-holders, but previously approved by the Forest Department; the partition of the wood among the inhabitants cannot be made until the work is entirely completed; the contractor is responsible, in all respects, as if he had been the purchaser of the produce, but he acts under the pecuniary guarantee of the body of right-holders, who cannot barter nor sell the wood made over to them, nor put it to any use other than that for which it is given to them; timber made over in satisfaction of a right, but not used within a period of two years, may be reclaimed by the Forest Department.

No right can exist to take goats into either the State or the communal forests, as the grazing of these animals is considered incompatible with the maintenance of the ground under wood. The old laws suppressed, without compensation to the right-holders, the practice of grazing sheep in the forests of the ancient royal domain of France; and the law of 1827 suppressed it also, on payment of compensation, in those State forests which are of more recent origin; but the Government has the power to permit sheep-grazing in certain localities, as an exceptional and temporary measure. No right to pasture any kind of animals can be exercised in any part of a forest, not declared out of danger by the Forest Department; which has also the power to limit the number of animals to be admitted, and the period during which they may graze, with reference to the condition of the forest and the quantity of grass in it. Right-holders can only pasture animals which they keep for their own use, not those kept for sale.

On the 1st January, 1877, about one-half of the total area of State forests was burdened with rights, of the estimated annual value of £38,400, while only ·3 per cent. of the communal forests were so burdened, the annual value in their case being estimated at £6,700. The commutation and purchase of rights, which was commenced in a systematic manner in 1857, is effected by the officers of the ordinary service, as well as by those who are charged with the framing of working plans. As a general rule, the arrangement with the right-holders is made by mutual consent, appeals to the Courts being of rare occurrence. The State is in no hurry to spend large sums in the purchase of grazing-rights, which will probably disappear with the progress of agriculture; a result which has already been realised in the north of France, where the greater portion of these rights has lapsed, through failure to exercise them.

(To be continued).

FOREST SETTLEMENTS.

THE old belief has not yet entirely died out that, when a forest is "*reserved*" *under Chapter II. of the Forest Act, it is thereby* handed over, "body and soul," to the tender mercies of the omnipotent Forest Officer, who will, thenceforth, manage it in a manner determined by purely sylvicultural considerations; and that, except as regards recorded rights, the exercise of which will be grudgingly permitted, the area will no longer be available to meet the requirements of the people in wood and fodder. Hence we find a great reluctance on the part of the Civil Officers, in some Provinces, to consent to bring forests and waste lands under the operation of the Act; and, when this is done, every endeavour is made to enlarge the record-of-rights to the fullest extent. Rights are admitted, not only to satisfy all possible requirements of the existing inhabitants of the surrounding villages, at the time of settlement, but also to provide for the largest conceivable increase of population, and for unlimited numbers of flocks, herds and buildings.

It is thought that, in this manner only, can the hands of the Forest Officer be sufficiently tied, to permit of forests being brought under Chapter II. of the Act. But it seems to be forgotten that the Forest Officer has no power at all, over the produce not absorbed by right holders, beyond that which he is allowed to exercise by the Local Government; which can frame its working plans and plans of operations, in any manner it pleases, so as to grow any kind of produce that the soil is adapted for, and to make it available, to any desired extent, on payment, for the use of non-right-holders. When the burden of rights is increased, it is not the Forest Officer's hands, but those of the Government, that are *tied*. *When once rights, in excess* of what the people can justly claim, are recorded, they can never be rescinded; and Government has, *pro tanto*, lost for ever the power it once possessed to utilize the forest, as may from time to time seem best in the public interest, and to draw revenue from it. Our administrators must, thenceforth, be content to see the produce eaten up by persons who never had any legal claim to it, and to forego the revenue that might have been realised, had the power to sell it not been unnecessarily parted with.

It is the duty of the Settlement Officer to ascertain and record what the rights of the people *actually are*, in accordance with the ordinary law on the subject; and not to record what he *thinks their rights ought to be*, in order to effectually protect them from the Forest Officer. No rights can possibly be recorded which involve a consumption in excess of the productive power of the forest; for if such rights are exercised, they can only result in the reduction of the property to a condition in which it is no longer *capable* of yielding what the Forest Settle-

ment Officer is so desirous of securing for ever to the people. Hence, before rights are admitted and recorded, the Forest Officer's professional opinion should always be taken, as to whether it is or is not within the capability of the forest to meet them.

All forests which are to be permanently maintained, and which are not so much burdened with rights that there is nothing, or but little, left for Government to deal with, should be brought under Chapter II. of the Forest Act; and the record-of-rights should be reduced to the minimum that considerations of justice and fairness admit of. Government will thus have at its disposal as large a surplus as possible, to be used, as it may from time to time direct, to meet the requirements of persons other than those residing in the immediate neighbourhood of the forest, and to produce revenue for the relief of the tax-payers.

To create inalienable rights, which were non-existent at the time of settlement, is to cause the general body of tax-payers of the present day to make, on behalf of themselves and their successors, a valuable present to persons, who had no legal claim to do more than divide its value with them; and to grant these persons the power to transmit the property to their heirs or aftercomers for ever. As the value of forest produce increases:—1*stly*, owing to the gradual extinction of private forests, and (it may be added) of those Government forests which are voluntarily sacrificed, through the admission of rights they are quite incapable of meeting; 2*ndly*, owing to the improvement of communications, which enables timber, in places formerly inaccessible, to be taken to distant markets;—it seems certain that this question will attract the serious attention of our State Financiers, who are not likely to regard the malversation of their legitimate resources with equanimity. When that time arrives may they not find the words TOO LATE written on the door!

In the case of State forests, burdened with legitimate rights to the full extent of their productive power, it must be a matter for consideration, in each case, whether or not the paternal Government deems it advisable, in the interest of the right-holders, to bring the area under Chapter II. of the Act, and go to the trouble and expense of a forest settlement, in order to maintain the capability of the forest to satisfy the rights. Should this not be done, the gradual destruction of such a forest is, in most cases, only a matter of time.

We invite the attention of our readers to an article in the "Civil and Military Gazette" of the 9th August on the subject of "the *Chos* of Hoshiarpur," which clearly sets forth the disastrous results that have, in that district, followed on a "liberal" settlement, made about the year 1847, in the *supposed* interests of the resident population. We cite also the case of the Ajmere hills, handed over, some half century ago, to the tender mer-

cies of the people, with the result that they have been completely denuded. Will not these suffice as a warning, or are we to manufacture more examples for the "information and guidance" of our successors?

SYSTEMATIC BOTANY AT THE FOREST SCHOOL.

THE Government of India has deputed Mr. J. F. Duthie to give a six weeks' course of lectures in Systematic Botany at the Dehra Dún Forest School, and in future years this will be extended to a two months' course, so that here is sufficient proof that this subject will not be neglected at Dehra. Some of the Senior Students have collected herbariums during their outdoor course in the Dún and Jaunsár, and Mr. Duthie will decide which of these collections is entitled to a prize, and the fact that students cannot obtain an honour's certificate, unless they pass a creditable examination in Systematic Botany, will keep up a considerable interest in the subject at the Forest School.

Our correspondent "Tau-tha" considers our foot-note to his letter last month as unnecessary, and that his language did not imply that Systematic Botany was to be no longer taught at Dehra, but we thought that possibly it might be imagined that Systematic Botany was in future to be entirely neglected in the instruction of ordinary Rangers, and therefore added the foot-note.

The fact is that, many of the Rangers' class are sufficiently weighted already with the number of subjects taught at the School, and what is desired in Systematic Botany is to give them sufficient practice in nomenclature of plant parts and in describing specimens, so that after leaving the School, those amongst them who have a real liking for the subject may continue to study it, at their leisure.

It might be possibly a good plan to treat the Entomological teaching at the Forest School in the same way as "Tau-tha" suggests, making it only an honours' subject.

"Tau-tha" holds the opinion that "to teach a man a subject in which he is neither obliged to pass, nor even to be examined unless trying for honours, is almost, if not entirely, useless."

This is rather a utilitarian view to take of knowledge, and we hope that some of our Forest Students may learn to love knowledge for its own sake, and not for the marks it enables them to gain in an examination.

As a matter of fact, the whole class are still examined in Systematic Botany, both during the course of the lectures and at their close.

In "Tau-tha's" letter in our August Number, there are a few mis-statements, for instance, the manipulation of the microscope

by the Forest Rangers' class is not compulsory. Microscopes are merely used to show the minute structure of plants, and at present only two men, *both B.A.'s* and candidates for honours, learn to manipulate the microscope.

"Tau-tha's" references to difficult words in the Morphological and Physiological course of Botany, and to doubtful theories of Sachs, are also misleading; the students are not expected to learn all these difficult words, though we must give names for ideas, and scientific names for plants, the local names of which are not sufficiently general, and doubtful theories are not taught, or even referred to, in these lectures.

The main teaching at the Forest School is necessarily confined to sciences leading up to Forestry, and with a clear practical bearing on their future work, and it is too much to expect that all Forest Rangers should be able to use a Forest Flora usefully.

The question of examinations at the Forest School did not come before the Forest Conference at all, so that if "Tau-tha's" wish that, the opinions of Members of the Conference should have been taken on this point, had been carried out, an entirely new field of enquiry would have been before the Conference.

USE OF SEMAL WOOD FOR PACKING CASES.*

I HAVE ventured to send you a sample of wood which has been sent to us for identification, but which we fail to make anything of. The wood is part of a case, one of a consignment, many of which arrived in the same condition. They contained castor-oil, and were shipped with a cargo of rice to the West Indies.

The damaged condition of the cases has been a source of considerable annoyance to all the parties concerned, and one of the lines of ships now refuse to ship castor-oil with rice cargoes, as I understand the deterioration of the wood is ascribed to the heated rice. This does not seem to me tenable, and I am under the impression that the wood used for the cases is semal, or some other inferior kind, and not mango wood as the shippers believe. I have taken the liberty of applying to you, as I have no doubt you will have no difficulty in telling us authoritatively what the wood is, and thus materially helping shippers to guard against such an occurrence in future. Trusting to be favoured with your assistance.

In reply to your note of the 23rd instant regarding some wood used for packing castor-oil, and a sample of which I received from you, I write to say that both I and the Deputy

* Copy of correspondence between the Deputy Secretary, Agricultural and Horticultural Society of India, and the Officiating Director, Forest School, Dehra Dun.

Director of the Forest School, Mr. Smythies, have carefully examined the wood, and that there can be no doubt that it is semal.

The pores are large and frequently sub-divided, and the surrounding tissue is very soft; the medullary rays are less numerous and fine than in mango wood, and the appearance of the wood exactly corresponds with that of specimens of semal in the Forest School Museum, having brown spots between the medullary rays.

The structure of mango wood is very different, and its texture much harder, and I send you specimens of mango and semal wood for comparison.

I am greatly indebted to you for your kind and prompt attention to my letter, and for the full and complete reply you have favored me with. The samples also have come to hand, and I *observe the difference you point out. These I will send back* in a few days, as I see they are numbered, and no doubt form a portion of your museum.

The opinion you have expressed will be a relief to shippers of castor oil with the West Indies, for as I mentioned in my previous letter, the owners of one of the line of ships refuse to take the oil with cargoes of rice, almost the only cargoes which ships take from this port. If shippers will guarantee the cases to be mango wood, I do not suppose there will be any further objection to shipping than there used to be previous to the occurrence.

Thanking you again for your valued assistance.

DEHRA DUN FISHING ASSOCIATION.

I WAS rejoiced to see a note on fishing in your August Number, and quite agree with your correspondent that it is a subject worthy of the "Indian Forester." The only drawback to making this journal the organ of Fishing is that numerous keen anglers never see the "Forester," and send their notes to the "Asian" instead, and it is undoubtedly to the latter that we must look for information on the subject. Still that need not prevent a stray note now and then being published in the "Forester."

A Fishing Association has recently been formed at Dehra Dún, somewhat on the same lines as the North Punjab Fishing Club at Rawal Pindi. The number of Members is at present about 65, and the principal objects of the Association are as follows :—

"I. To collect and publish trustworthy evidence as to the wholesale destruction of fish by netting which now goes on. Not only are spawning fish netted in the rains, but small fry are ruthlessly destroy-

ed throughout the year, especially in the Asan river. Definite evidence on this head, which may happen to fall under the personal observation of members, is required. Fish are also destroyed by damming up the streams for irrigation.

"II. To increase the stock of fish in the Dún as a source of food supply for the people, by inducing the landholders and proprietors along the banks of the streams to put a stop to netting, and as far as possible to give the Association control over the waters, so that fish during the breeding season, and the small fry, may be preserved.

"III. To encourage rod fishing, and to give assistance and information to members in regard to all that appertains to fishing in the Dún. To collect and record notes regarding seasons, different kinds of fish, localities, bait, &c.; to publish a map showing the main rivers, roads, camping places, &c.; and generally to further angling as a legitimate sport, among Europeans and Natives.

"IV. To work in co-operation with the North Punjab Fishing Club in *eventually pressing upon Government the necessity of legislation* on the subject."

Any further information will be gladly supplied by the Honorary Secretary, Dehra Dún Fishing Association, Dehra Dún, N.-W. Provinces.

ANGLER.

VISIT OF M. USSELE TO INDIA.

M. USSELE, garde générale of French Forests, who has been sent by his Government to report on the forests of Japan and India, and, it is believed, of Java and Cochin China also, has lately passed through Dehra on his way to Simla. From Simla he travelled *viâ* Changa Manga to Poona and Bombay. In the School Circle he saw improvement fellings in sál forest, and also the unimproved forest. As far as possible he was shown the methods adopted for fire-protection, but as the rains had already broken, and the lines had become green, he could not properly see the way in which the work is done. Indeed, *it seems probable that, coming as he did just after the rains* broke, when everything was green, but whilst the new grass was not as yet high, he will carry away a wrong impression of our work in India, and, especially of the difficulties of fire-protection. After visiting the sál forests M. Usséle proceeded to Deota, where he saw the timber works, slides, and so forth. While in Jaunsár he visited Koti Kanasar, where he could see the wonderful effect of fire-protection on kail (*P. excelsa*) reproduction. On his return from the hills M. Usséle visited the Forest School; he left for Simla on the 20th July, and has subsequently visited the *Chos* of Hoshiarpur, the condition of which, causing an annual devastation of the country, and suspension of traffic on the N.-W. State Railway, he considers perfectly remediable by proper protective measures. We pub-

lish the following letter addressed by M. Ussèle to Lieut.-Colonel Bailey, the officiating Inspector General of Forests :—

MONSIEUR,

La prolongation du délai fixé pour mon voyage ne m'est pas parvenue, je n'ai pas reçu aucune réponse à la lettre par laquelle je la demandais, je ne puis croire qu'elle m'ait été refusée, mais dans le doute s'il faille qu'il puisse être, il m'est impossible de rester plus longtemps aux Indes et demain je m'embarque à bord du Rebattins pour rentrer en France.

Je me suis arrêté après la visite à Poona que j'ai d'ailleurs du faire très courte pour revenir à Bombay, et tout ce que j'ai vu me laisse en profond regret de n'avoir pu voir plus encore : les magnifiques forêts de l'Himalaya, les travaux prodigieux de Changa Manga, les efforts tentés pour reparer les degradations commises dans le centre de la province de Bombay, m'indiquent qu'il y a une mine d'études importantes à explorer dans l'Inde.

Ce travail ne m'est plus possible, mais le temps seul m'a manqué pour cela, car je dois vous adresser pour tout le corps des Forestiers de l'Inde mes remerciements de l'accueil infiniment obligeant qui m'a été fait partout.

J'emporte donc le meilleur souvenir des instants que j'ai passés au milieu de vous, et vous prie d'agréer le témoignage de ma profonde reconnaissance et de mes sentiments respectueux et devoués.

BOMBAY, 19*th Août*. L. USSELE, *Apt, Vaucluse*.

SEEDING OF BAMBOOS.

ABOUT five years ago there was a general seeding of the ordinary bamboo (*B. Arundinacea*) and the culms died down. Ever since then there has been great difficulty in procuring bamboos of good size.

What I wish now to ask is, if it is possible by cutting out the bamboos before they seed, to avoid this general seeding,* and so have a supply coming on and in full vigour in one place, while in another the bamboos have matured and are dying.

TRAVANCORE,
July 23rd, 1887. T. F. B.

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* There is probably no way of preventing the general seeding of bamboos, when they become mature.

The *B. Arundinacea* seeded universally in Dehra Dún in 1881-82, and the young clumps are now approaching their parents in size.—[ED.]

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FORESTRY IN FRANCE.

(*Continued from page* 402).

GRAZING.

Goats, sheep, and cattle have always been the enemies of forests, and are indeed the principal agents of their destruction, especially in hot and dry climates, where the vegetation is not sufficiently vigorous to resist the effects of over-grazing.

Animals are admitted to the forests under three different conditions, *viz.* :—

(*a*). In virtue of a right of user.

(*b*). As a means of raising revenue, and of utilising the grass.

(*c*). By tolerance, as a temporary arrangement.

Grazing by Right.—This has been treated of in the preceding section.

Grazing as a means of raising Revenue and of utilising the Grass.—Neither goats nor sheep are admitted into the State or communal forests with this object. In the State forests, it is sometimes the custom to allow cottagers, living near the forest, to graze their cattle in exchange for a number of days' work; but this is not done to any important extent. In these forests, in fact, very little grazing is sold; for the practice can only be permitted in the unwooded portions, which are rarely available for the purpose, because, although they are of considerable extent (about 450 square miles), they are either required as grazing grounds for the cattle of right-holders, or are being planted up; hence the revenue from this source is insignificant. It was only £360 during the last year for which the record is available. But it is otherwise in the case of the communal forests, where local custom often necessitates the maintenance, as pasture land, of blanks, which could otherwise be most advantageously filled up; and some communes derive almost their

entire revenue from this source. The receipts by them amounted, in the same year, to nearly £15,000.

Grazing by tolerance.—It has been said that no right can exist, to graze either goats or sheep in the State or communal forests; and the inhabitants of the communes are specially prohibited, by law, from admitting their own goats and sheep into their forests; but the Government has the power to sanction the grazing of sheep (not goats), in certain localities, under exceptional circumstances. Permission to drive sheep into the State forests is, however, very rarely accorded, except in seasons of extraordinary drought, when the flocks of the neighbouring communes are sometimes admitted for a single season. But in the case of the communal forests, such temporary sanction is, of necessity, more freely accorded. For the forests belong to the inhabitants; and even though their true interests might be better served by keeping out their sheep entirely, it is not found possible to change their pastoral habits all at once; and, on this account, permission has frequently to be granted them to graze their sheep in their forests, either for a single year, or for periods up to five years. They can, however, graze their own kine, horses, ponies, donkeys, and pigs there, without special permission; and they usually do so, on payment of a fee into the communal treasury. According to the latest available record, the number of animals of all kinds thus admitted to their forests in a single year was as follows, *viz.*:—

Kine, horses, ponies, and donkeys, .	359,164
Pigs, ...	48,388
Sheep (by special sanction), ...	936,960

The animals can, however, only be grazed in places which have been declared out of danger by the forest officers, and their numbers can be limited with reference to the quantity of grass available. But it is not always possible to enforce these restrictions rigidly; and the forests, in certain regions, have much to contend with, from the extent to which grazing is practised. The receipts by the communal treasuries, on this account, have been estimated at 4*s.* 6*d.* per head of large cattle, 3*s.* 11*d.* per pig, and 1*s.* per sheep; but this only represents an average revenue of 10*d.* per acre of the area grazed over, whereas wood yields, on an average, about 8*s.* 4*d.* per acre; and it seems probable that this consideration may gradually lead, in the agricultural districts at any rate, to the abandonment of the practise of pasturing cattle on forest lands. There is no doubt that when grazing, even by large cattle, is permitted, it is carried on at the expense of the crop of wood; and that where it is practised to any considerable extent, the forest, properly so called, tends to disappear. This is notably the case where, for the time being, local circumstances, such as the absence of export roads, render wood a less profitable crop than grass; here

the forests gradually become almost unproductive, and finally succumb before excessive grazing.

About four-fifths of the total area of the communal forests are still used as grazing grounds, nearly one-half of the latter being open each year. Separate grazing grounds are allotted for each class of animals, the average area provided for each being about 3 acres per head of large cattle, 2 acres per pig, and ⅗ of an acre per sheep. These figures represent the average of all qualities of pasture land; they could not, therefore, even supposing that the grazing were not excessive, be taken as a guide to the area necessary per head of cattle, pigs or sheep in any particular locality, even in France, and still less so in other countries.

Offences.

Until the year 1859, persons charged with offences against the Forest Law, had always to be tried by the Courts; but in that year a law was passed, which enabled the Forest Department to take compensation from offenders, instead of bringing them before the tribunals; and this method of dealing with them is now largely practised. The Department has always power to charge the delinquents before the Courts; while they, on the other hand, have the right to refuse payment of the compensation demanded, and thus to bring about their formal trial. Officers of lower rank than that of Conservator are not, however, authorised to deal with cases in this manner, and the power of the Conservator is limited to the acceptance, by way of compensation, of sums not exceeding £40; if it is desired to exact a larger amount, the sanction of Government must be obtained.

This system has many advantages. For while it is necessary, in the public interest, that infractions of forest rules should be checked, a larger proportion of them is usually of a petty nature; and, in many cases, the persons who commit them hardly deserve the severe penalties they must suffer, on being found guilty by the Courts. The system of taking compensation permits the adoption of a scale of punishment more suited to this class of offenders, while it, at the same time, admits of the means of the delinquents, and the attendant circumstances of each case, being taken into account. The punishment can also be made to follow promptly on the committal of the offence, without the necessity for dragging the accused and the witnesses from their occupations to attend before a tribunal. A further advantage is that the time of the Courts is not occupied in the trial of these petty cases. The present system is easy and simple for the Forest Department; and that it acts very leniently on the population living near the forests will be seen, when it is stated that the amount of compensation, exacted during the last year

for which the record has been prepared, amounted to only one-fifth of the sum the Courts must have awarded, had the offenders been proved guilty before them. Occasionally, the compensation is allowed to be paid in the form of a number of days' work done in the forest.

With the advancing prosperity of the country, forest offences become less frequent, the number now committed annually being very much smaller than it used to be a few years ago. It is worthy of remark that such offences are more than twice as numerous in the communal as they are in the State forests, probably because individual inhabitants of the communes do not see much harm in committing minor depredations on property they doubtless regard as their own. During the year 1876, the number of offences was 26,377 ; 3 per 1,000 acres having been committed in State forests, and 7 per 1,000 acres in those belonging to the communes. More than half the offences were connected with the theft of wood or injury to trees, and nearly a quarter of them related to pasture and cattle trespass ; a total of 31,231 persons were involved in the charges. As might be expected, wood-stealing is more prevalent in winter than in summer, while the reverse is the case with regard to breaches of the grazing laws. Of the total number of charges made in 1876, 7 per cent. were abandoned, either owing to the trivial nature of the offences, or to want of sufficient evidence ; 70 per cent. were dealt with under the compensation law ; and the remaining 23 per cent. were taken into court, convictions being obtained in 99 per cent. of these cases.

In addition to clauses dealing directly with wood thefts, illicit grazing, and other fraudulent practices, the Forest Law provides that no person, carrying cutting instruments, can leave the ordinary forest roads ; and that no fire can be either lit or carried within, or at a less distance than 200 yards from, any forest boundary. A regular tariff exists, fixing penalties for damage to trees of various ages and species. The law also prohibits the erection, without permission, of brick or lime kilns, carpenters' shops, timber-yards, or saw-mills, within certain distances of the forest. At the time the law was passed, it was much more necessary than at present to check the erection of such buildings, and applications for permission to construct them are now usually accorded on suitable conditions.

INJURIES CAUSED BY WILD ANIMALS AND INSECTS, STORMS AND FIRES.

Wild Animals and Insects.—The principal wild animals which cause injury to the forests, either by devouring the seed or the young seedlings, or by peeling the bark off the young plants, are deer, pigs, hares, and rabbits. The insects, which attack the leaves, the bark, and even the wood of the trees, belong

chiefly to the families *Coleoptera*, *Lepidoptera*, and *Hymenoptera*. But the damage done by them is not excessive, and is, in fact, far less than that experienced in many other countries. It is, of course, exceedingly difficult to put a money value upon injuries of this sort, which include not only the actual death of a certain number of old and young trees, but also a reduction in the rate of growth of others. An estimate was, however, made of the damage done in 1876, which is said to have amounted to about 4*s.* per 100 acres, taken on the entire area of the State and communal forests. Coniferous trees usually suffer more than broad-leaved species, as they are frequently killed outright, whereas the latter more often merely suffer a diminution in their rate of growth.

Storms.—The damage done by storms is a much more serious matter. Injuries to the forest are caused by them, which it is not always possible to prevent, or even to modify. In the first place, windfalls interfere with the arrangements laid down in the working plan, and the arrangements for the execution of fellings are thus thrown out; they remove too large a proportion of the seed-bearing trees, and, consequently, it is sometimes necessary to substitute a difficult and costly artificial process for the natural regeneration, which would otherwise have been effected; in addition to this, they break, or otherwise damage, neighbouring trees by their fall. In the second place, the value of the windfalls themselves is, speaking generally, small; as they are frequently broken or otherwise injured, and many of them have not attained the age or dimensions at which it was intended they should be felled. They are also specially liable to attacks by insects, which often appear, in large numbers, in forests where many trees have been blown down, particularly in the case of coniferous species. Even uninjured windfalls fetch a lower price than trees felled in the regular manner, because they are usually found scattered here and there, instead of being concentrated in one part of the forest.

The year 1876, which is the last for which figures can be obtained, was a disastrous one, the amount of windfalls being exceptionally large, probably double that of an average year. The number was put at 1,145,708 trees, and the damage caused was estimated at £10,300, or about £3 4*s.* per 100 acres in the State forests, and 12*s.* per 100 acres in those belonging to village communities. The latter being, for the most part, coppice with standards, suffered less than the former; but the proportion of windfalls in the coniferous forests was greater than that in forests of broad-leaved species. The windfalls were sold for nearly £621,000.

The forest officers, when arranging the annual fellings, are careful to provide, as far as possible, against storms, by leaving a protecting belt of standing trees on the side of the forest from which the dangerous winds blow, and in other ways; but the

effect produced depends mainly on natural conditions beyond human control, such as the configuration of the ground, the shelter afforded by neighbouring hills, the nature of the soil and its physical condition, as well as on the kinds of trees and their root development, their size, age, and the system of treatment to which they have been subjected.

It may be added that hailstorms often do great damage by stripping the trees of their foliage, and by breaking or otherwise injuring the young plants.

Fires.—The Penal Code provides for the punishment of persons who cause forest fires, whether intentionally or through carelessness; and the Forest Law prohibits the lighting or carrying of fire either inside the forests or within 200 yards of their boundaries; but neither of these laws prevents proprietors from lighting fires in their own forests, to the danger of their neighbours' property. This is an important question in the Maures and Esterel,* where the bad practice prevails of systematically lighting fires in the forests, in order to burn up heather and other shrubs which interfere with the regeneration of the crop of trees. In 1870, a special law was passed, prohibiting the proprietors of those districts from lighting fires in their forests, except at seasons fixed by the Prefect; and also compelling them to clear fire-lines round all woods and forests not completely freed from inflammable shrubs.

In 1876, 290 fires occurred in the area managed by the Forest Department, nearly all of them being the result of accident. The surface burnt over measured 2,350 acres, or about $\frac{1}{3000}$ part of the entire area, and the damage was estimated at £3,280, or 28*s.* per acre of forest burnt. The proportion of fires was greatter in the broad-leaved than in the coniferous forests; but, on the other hand, the amount of damage done per acre in the latter, was three times as great as that in the former, as the resin in the trees themselves, and in the dead needles on the ground, render fir and pine forests excessively inflammable. It is also worthy of remark that, although, as a general rule, fires were of more frequent occurrence in the spring than at any other season of the year, the autumn fires were, on account of the recently fallen leaves, far more destructive. But this is by no means true of all regions; and the general result may be mainly ascribed to the great damage done by fires occurring, during the autumn, in the south of France. In the north, forest fires are of small importance, and occasion little damage.

Hunting and Shooting.

The right to hunt and shoot in the State forests is, generally speaking, let out on nine years' leases, sold by public auction,

* Low mountain ranges in the South of France.

under the rules for the sale of timber and other forest produce; but, when this is not possible, it is sold by means of annual permits, issued under the direct authority of the Minister of Agriculture, the sport being always carried on under the surveillance of the officers of the Forest Department. No forest officer can lease the shooting within the limits of his own charge, and forest guards are never, under any circumstances, permitted to shoot in the forests.

The Municipal Councils are, subject to the approval of the Prefect, free to dispose of the right to hunt or shoot in their forests, in any manner they wish.

Destruction of Wolves.

The destruction of wolves, boars, and other animals which are considered dangerous to man or harmful to the forests, is entrusted to a corps of 410 *Lieutenants de Louveterie* (wolf-hunters). These officers, who are unpaid, but have the right to wear a handsome uniform, are under the control of the Conservator of Forests, and are appointed by the Prefect, on his recommendation. They are, as a rule, landed proprietors, who accept their appointment for the sake of the sport it affords them. They are obliged to keep bloodhounds and packs of dogs, and are charged to organise and direct, in communication with the local forest officers, the *battues* ordered, from time to time, to take place in the forests. But as this system has not been found very efficient, a law has recently been passed, under which a reward, varying from £1 12*s.* to £7, is payable to any one who kills a wolf; and the mayors are authorised, when the snow is on the ground, to organise *battues* for the destruction of wolves, boars, and other animals, anywhere within the limits of their respective communes, on condition only that they give due notice to the proprietors of the land on which the beat is to take place. The rewards paid for killing wolves amount to about £4,000 a year.

CHAPTER III.

AFFORESTATION WORKS.

WORKS UNDERTAKEN FOR THE CONSOLIDATION AND PROTECTION OF UNSTABLE MOUNTAIN SLOPES.

Excessive grazing, both by local herds and flocks, principally of sheep and goats, as well as by vast numbers of these animals, annually driven up from the plains to the hill pastures, have produced complete denudation over very large areas, and have thus caused incalculable damage in the great mountain regions of France, principally in the southern Alps, and in the level coun-

try below them. The animals eat down the grass to the level of the ground, and then tear out the very roots, thus breaking up the surface of the soil, and rendering it liable to be washed down by rain. The hills are of a loose formation, the strata being contorted and dislocated to a remarkable degree; and as soon as the soil has been deprived of its protective covering of trees, shrubs, and herbs, whose roots held it together, the slipping and falling of the mountain sides is produced with a constantly increasing intensity. The rain water, no longer interrupted in its fall, nor retained by the spongy vegetable mould, nor hindered in its downward flow by the thousands of obstacles which a living covering would oppose to its progress, flows off the surface of the ground with extraordinary rapidity, and, carrying with it large quantities of loose soil, suddenly fills up the torrent beds. These latter, scoured out by the rush of water, charged with mud, stones, and rocks, cut their way deeper and deeper into the mountains; and their banks, deprived of support at the base, fall inwards, the *débris* being borne onwards to the level ground below. The cracks and slips, occasioned in this manner, extend to a great distance on either side of the torrent, especially on the side on which the strata slope towards it, and the effect is much increased when the upper stratum is loose, and lies upon an impermeable bed. The water then saturates the loose rock, and, penetrating through it, as well as down the cracks and fissures, flows over the hard surface, the superincumbent mass being consequently precipitated, either suddenly or by slow degrees, into the valley below. This effect is produced in the whole net-work of water-courses, both principal and tributary, which traverse the mountain sides; the upper strata, over enormous areas, with the fields, houses and even entire villages which they carry, being borne down into the valleys, and the whole region, which presents little to the eye but a series of unstable slopes of black marl, has an indescribably desolate appearance. It may be added that, when the hillsides are covered with trees, the snow, accumulated during the winter months, disappears gradually, under the influence of the milder temperature accompanying the advancing spring; but when the trees have been removed, and the masses of snow are consequently exposed to the full force of the sun's rays, they melt rapidly, and produce results, on the mountain sides, similar to those which follow the occurrence of heavy storms of rain.

But the damage does not stop here; for on reaching the comparatively level valleys forming the main lines of drainage of the mountain range, the stones, gravel, and sand, transported by the numerous torrents, are deposited. These valleys, being usually very fertile, are occupied by fields, villages, and towns, connected by roads and sometimes by railways, constructed with many bridges, retaining walls, and other masonry works;

and as by degrees, enormous areas become covered with *débris* —sometimes this result is produced suddenly and without warning—the buildings are either thrown down or overwhelmed, the railways and roads blocked, and bridges overthrown, while the fields are completely and irretrievably destroyed. The damage thus caused is most serious, both in its nature and extent; and to it must be added the great inconvenience and loss occasioned by interruption of traffic on the roads and railways. But this is not all. If the *débris*, transported by the torrent, is carried into the river before it can be deposited, it is either borne on at once, and thrown on to the level country lower down, or it remains, and turns the course of the stream over the fields and buildings on the opposite bank. Occasionally the deposit temporarily blocks up the valley, causing the inundation of villages and fields on the upper side of the barrier; and when this ultimately gives way, the most disastrous results ensue, both in the lower part of the valley, and in the open country at the foot of the mountain range. It is to mitigate these terrible evils, that the vast enterprise of afforesting the mountains has been undertaken, as the only means of dealing with them. But, owing to the enormous cost of the work, it cannot be hoped that the forests thus raised will ever prove directly remunerative, and their creation, with a view to their ever becoming so, could not for a moment be justified.

The works are of two classes, *viz.*: *(Firstly)*, The treatment of torrent beds, by a series of weirs and other structures, destined to bring them gradually, and by successive stages, to a normal slope; and thus, not only to prevent "scour," but, by filling up and widening the beds behind the weirs, to afford support to the unstable sloping sides, and gradually consolidate them, with a view to their being ultimately planted up. *(Secondly)*, The immediate planting up of all areas, the surface of which does not seem likely to be washed down, within the period occupied by the construction, in that locality, of the first class of works. A commencement was made in 1860; but the law passed in that year not having been found sufficient, a new law came into force in 1882, which provides both for the works to be undertaken directly by the State, and for those to be executed by the proprietors of the ground, with or without State aid, as well as or simple measures of prevention.

Works undertaken by the State.—The proposal to take up ground for this purpose emanates from the Forest Department, and is followed by a formal enquiry, under the direction of the Prefect, into the circumstances of the case, on which a special commission, with a forest officer as one of its members, makes a report. If the proposal be approved, a law is passed, declaring the work to be one of public utility; and under it the ground, with all existing rights, whether of the proprietor or of other persons, is bought by the State, either by mutual agreement or

by expropriation. The area is then under the forest law, and the works are undertaken at the public cost.

Works undertaken by the proprietors.—If, however, the proprietors, who are for the most part village communities, do not desire to part with the land, they must, before expropriation has been ordered, agree to execute the specified works themselves, within a fixed time, and to maintain them, under the control of the Forest Department. In some cases, but not always, pecuniary aid is then afforded to them. If the proprietors of land, outside the areas taken up for treatment as works of public utility, desire to undertake measures for the consolidation of the soil, or for the improvement of their pastures, they can obtain assistance from the State, in the way of money, seeds, plants, or of work done for them; but when any such aid is afforded, the operations are under the surveillance of the Forest Department, and in certain cases the money advanced has to be refunded.

Preventive measures.—When the condition of the ground is not such as to warrant its being dealt with in the above manner, it may, after the same preliminary formalities as before, be closed against grazing, for any period not exceeding ten years; and in this case compensation is paid, annually, to the proprietors, for their loss of its use. During this interval, the State has power to execute works, designed to promote the more rapid consolidation of the soil; but the nature of the property cannot be changed thereby, neither can the proprietor be called upon to pay anything for the improvements thus effected. If, after the lapse of ten years, it is found necessary to continue the exclusion of cattle, the State must buy the land, either by mutual agreement, or by expropriation.

But none of the measures above described would deal effectually with the situation, unless the source of the evil were, at the same time, attacked, by bringing the pastoral arrangements on the neighbouring hills under control, so as to avoid over-grazing; and the law therefore provides that in 313 village communities, all those in which works are undertaken being included, as well as many others, the grazing must be carried out in the manner approved by the Forest Department. These communes are, therefore, obliged to submit annual proposals on this subject to the Prefect, showing the nature and extent of their pasture lands, the portions they propose to use during the year, the number of animals of each kind that are to graze, the roads by which they are to reach and return from the pastures, and other matters. These proposals are considered by the Forest Department, and modified if necessary. In addition to this, with a view to encourage the pastoral population of the mountains to take care of their grazing grounds, and to put a stop to abuses resulting from ignorance and from the continuance of injurious customs, the Forest Department is empowered to

grant money rewards to *fruitières* (associations of cattle-owners for the manufacture of cheeses) for improvements made by them to their pastures. It is also desired to encourage, as far as possible, the substitution of cows for sheep; but the population of the mountains does not like the afforestation of their grazing grounds, and the principal reason for the offer of rewards by the State is, that it is considered politic to aid them in their industry, as some set off against the inconvenience to which individual communities are sometimes put by these operations.

Scope and progress of the entire work.—The total surface to be treated as a work of public utility in the Alps, Pyrenees, and Cevennes, is estimated to amount to 1,035 square miles, including about 1,900 linear miles of torrent beds. Up to the end of 1885, 152 square miles of this surface, and 373 miles of torrent beds, had been completed; the expenditure amounted to £819,320, and the rates varied from £3 2*s.* to £6 3*s.* 6*d.* per acre, and from 2*s.* to 7*s.* 6*d.* per linear yard of torrent bed. There remain to be treated, therefore, about 883 square miles of surface, and 1,500 miles of torrent beds. In addition to the above, the State has paid £138,000, or half of the cost of treating 212 square miles as "permissive works" under the old law; and £12,000 towards pastoral improvements.

Draining and Planting of Swamps and Waste Lands.

Measures of the nature above described, for the consolidation and protection of mountain slopes, are undertaken in the interest of the population generally. In the case of sterile unproductive wastes or swamps, which do not require to be dealt with on these grounds, the Government has thought it better, as a general rule, to leave each proprietor free to do what he considers most to his own advantage, confining itself to the exemption from taxes, for thirty years, of all such lands that are planted up. But the State has the right to force the communes to drain their swamps and wastes, with a view to rendering them suitable either for cultivation or for the growth of trees; and when this is done, advances of funds may be made, under certain conditions, one of which is that the commune has the right to surrender to the State, in satisfaction of all claims, a portion of the area not exceeding one-half.

The *Dunes* of the West Coast.

The winds that blow continually from the ocean on to the west coast, carry with them enormous quantities of sand, which, advancing steadily over the country, at the average rate of some 14 feet per annum, in the form of moving hills called *dunes*, bury under them the fields and villages they reach. It has been calculated that nearly 90 cubic yards of sand per yard of coast

line are thus annually transported inland. Works to arrest the destructive effects of this invasion of sand have been in progress since 1789; they were originally carried out under the Department of Public Works, but since 1862 they have been placed under the Forest Department. The total area of the *dunes* is said to be 224,154 acres, a part of which belongs to the State, and a part to private owners, a much smaller portion being communal property.

In exposed situations, the protective works consist of a wooden palisade, erected at a short distance above high-water mark, and destined to promote the formation of an artificial *dune*, with a view to prevent fresh arrivals of sand from being blown over the country. Under its shelter, seeds of various kinds, principally those of the cluster pine (*Pinus maritima*), broom, gorse, and gourbet (*Arundo arenaria*), are sown, the seeds being covered with brushwood, so as to prevent the sand in which they are sown from moving; the sowing is thus continued inland, in successive belts, until a crop of trees is raised on the entire area. In less exposed situations, a wattled fence is substituted for the wooden palisades. In the departments of Gironde and Landes, forests of the cluster pine have been most successfully raised in this manner; the trees are tapped for resin, and the wood of those exhausted is sold for railway sleepers and other purposes. But north of the Loire the cluster pine is not sown, as in that region it does not yield resin in sufficient quantity to repay the cost of its introduction, and here it is sought merely to establish a crop of grass on the ground.

The law of 1810, relative to the treatment of the *dunes*, which is still in force, provides that the Government can order the planting up of any area which, in the public interest, requires to be so dealt with. When the land, or any part of it, belongs to communes or private proprietors, who cannot, or do not wish to, undertake the work, the State can execute it, reimbursing itself, with interest, from the subsequent yield of the forests. As soon as the money so advanced has been recovered, the land is restored to the proprietors, who are bound to maintain the works in good condition, and not to fell any trees without sanction of the Forest Department. This system of raising forests on private lands would not be likely to succeed elsewhere; but here, the extremely profitable cultivation of the cluster pine, due to the large quantity of valuable resin that it yields, in the hot and moist climate of the south-west coast, renders it a safe transaction for the State to engage in.

Before the Forest Department took over the work in 1862, 111,787 acres had been dealt with; and the entire area has now been completed. The works have to be most scrupulously maintained, in order to prevent a recurrence of the evil.

(*To be continued*).

COMPOUNDING FOREST OFFENCES.

"A. J. C." in his note on compounding of forest offences says, "without it, forest work would come to a standstill." From the context I gather that the forest work spoken of is what was described by a writer in the "Forester" lately as the "cut-and-come-again-system." If so, I would ask "A. J. C." if it would not be better that it should come to a standstill, and so necessitate the introduction of a system a little more in accordance with forestry than this relic of barbarism. Apart from this however, may I ask "A. J. C." to give us some details of what he is longing for. How low down the scale does he propose to give powers under Section 67? Scarcely to Rangers I should think, and if so, does he intend each case to be compounded *personally* by the Divisional Forest Officer, or will he be satisfied by his doing so at the tail end of a vernacular correspondence? I have some experience of this latter system, and I look upon it as simply fatal, not only to forest working, but even to conservation. It demoralizes the subordinates and the people by its close resemblance to "black mail," and even where subordinates are perfectly honest by the temptation to slovenly preparation of cases, for it is much easier to get an offender to confess to an offence on the distinct understanding that the offence shall be compounded than to work up the case so as to secure a conviction before a Magistrate.

I would give a good deal to see Section 67 expunged from the Act, and a minimum punishment substituted. In my opinion the secret of successful working (I include conservation and improvement in the term) lies not in the direction of compounding offences, but in securing deterrent punishments for offenders.

Section 67 is possibly suitable for cases in which the offence is one against the revenue, as in the license, permit, naka (or whatever name it may bear) system of irregular uncontrolled exploitation, but where conservation and improvement are aimed at, my bitter experience is that Section 67 is a curse and not a blessing.

GHATI.

PERIODICAL RAIN-GAUGES.

In March 1883, the "Indian Forester" gave a description of a periodical rain-gauge. The seemingly unavoidable evaporation in the rain-gauge during rainless intervals was allowed for by the addition of a second gauge, which was as much as possible of the same pattern as the first, except *that it did not receive* the rain. A certain height of water was introduced into gauge No. 2, and exposed to evaporation as nearly as possible alike

to the evaporation which took place in No. 1. The evaporated water of No. 2 was added as a correction to the rainfall of No. 1.

By this method the evil was so far overcome from which all periodical rain-gauges appear to suffer, but the apparatus was rather complicated, and yet there must have remained some uncertainty as to the result.

Mr. Clifford was lately looking out for a suitable pattern of rain-gauges to be put up in so many torrent basins of the Sewaliks (Saharanpur Forest Division, Forest School Circle). His enquiries caused me to consider some other means of avoiding the errors and complications which the evaporation of the water brings about in periodical rain-gauges. It appears that I have found a remedy. It consists simply in the use of a layer of oil which covers the rain water. Under the sheltering surface of the oil, the rain water once collected remains stored almost indefinitely without evaporating, no matter what the temperature or the dryness of the air may be. It is only necessary that the oil should be of good quality, so as not to thicken during a period of from three to six months, but otherwise I cannot think of any objection. If the experiments should prove that the oil answers the purpose fully, then it would be possible to establish a great many of such periodical rain-gauges in forests where continuous observations are impossible.

H. WARTH.

SQUEAKING CATERPILLARS AND MOTHS.

It has long been known that the Death's-head Hawk-moth (*Acherontia atropos*) makes a squeaking noise when it is handled; but I have never seen it stated that the caterpillar of this moth also makes the same noise.

Last June I got a caterpillar of one of the *Acherontiæ*, it was full grown and quickly changed into a chrysalis, and came out on the 15th August; it proved to be a fine male, but though not *atropos*, it was one very like it.

When the caterpillar was stroked on the back it made the very same squeak that the perfect moth did; I tried to find out how the squeak was made, but could not.

In Kirby and Spence's Entomology the question as to how the noise made by the perfect insect is done is discussed, and the conclusion come to is, that it is not owing to the friction of any of the external members, which has hitherto been assigned as the cause, but that the noise is most likely internal; and that the true cause remains to be discovered. It is there however stated that the noise is sometimes made by the moth just before issuing from the pupa.

From what the boys here, who rear caterpillars, tell me, there are several kinds which make this squeaking noise; this kind is the only one I have heard, but next rearing season I will pay more attention to the subject.

A. C.

FORESTRY IN CEYLON.

A CORRESPONDENT has drawn our attention to what he terms a spiteful attack on Mr. Vincent, on page 382 of our August Number, in the extract from the "Indian Agriculturist" regarding Ceylon.

We really regarded it, as the greatest praise for Mr. Vincent to be attacked by a Ceylon Tea Planter, and the remarks about the highly coveted blocks of forest land suitable for tea, which had been withdrawn, on Mr. Vincent's report, show the real reason for the grudge against him.

Our own opinion on the great value of Mr. Vincent's work in the Ceylon forests, has already been freely given in our pages, and we did not expect that the extract from the "Indian Agriculturist" would take in any one.

We may say that Dr. Meyer, when in Dehra, expressed his views about the miserable short-sighted policy which was denuding the forests of Ceylon for tea planting, the roots of which could in places only hold on to the soil for a few years as the rush was so great, when once the forest had been cleared.

It may now be confidently expected that Mr. Thompson will speedily bring the wreck of the Ceylon forests into proper control, and he has all our best wishes for his success in the great work before him.

BAMBOOS FOR LANCE-STAVES.*

THE bamboos must be what are known in India as male bamboos, *i.e.*, without any hollow in the heart.

They should be cut when the sap is falling† and straightened at once, care being taken not to burn the outer skin or injure it in any way. They should then be well oiled all over with common country oil (mustard oil) mixed with a little petroleum, which will keep the fly or worm from touching them. When oiled they should be tied in bundles of convenient size, covered with sacking, and sent home through the canal as soon as possible after they have been cut.

* Memorandum, dated 21st March, 1887, by Major W. M'Clintock, R.A.

† We do not know what is meant by the 'sap is falling.' Bamboos should not be cut till thoroughly mature, *i.e.*, two or three years old, or even older, according to the species in question.—[ED.]

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FORESTRY IN FRANCE.

(Continued from page 450).

CHAPTER IV.

ADMINISTRATIVE ORGANISATION AND DEPARTMENTAL STAFF.

Administrative Organisation.

In order to carry out the work briefly described in the preceding Chapters, a corps of professional foresters, composed as follows, is maintained, *viz.* :—

1	Director of the Forest Department.	*Superior Staff.*
9	*Inspectors-General.*	
39	Conservators.	
245	Inspectors.	
234	Assistant Inspectors.	
308	Sub-Assistant Inspectors (*Gardes généraux*).	
3,532	*Brigadiers* (*Head Guards*) and Guards,	*Subordinate Staff.*

This body of officials is employed, partly in the ordinary duties of the department, as being in administrative, executive, or protective charge of the units into which the forests (including those of Algeria) are grouped, for their more efficient and convenient control; partly in special branches, such as those charged with the preparation of working plans, with the treatment of unstable mountains, and with the communal grazing arrangements; and partly also in the Central offices at Paris. The following statement shows the number of officers of the superior staff employed on each kind of duty :—

	Director.	Inspectors-General.	Conservators.	Inspectors.	Assistant Inspectors.	Sub-Assistant Inspectors.	Total.
Central offices,	1	8	...	10	12	2	33
Ordinary duties,	...	...	35	180	177	209	601
Working-plans branch,	...	...	...	15	14	6	35
Consolidation of mountain slopes,	...	...	...	15	12	49	76
Communal grazing,	.	...	...	2	2	1	5
Schools,	...	1	1	3	6	...	*11
Algeria,	...	...	3	17	10	37	67
Detached duty,	...	...	...	3	1	4	8
Total on active list,	1	9	39	245	234	308	836

The Central Offices at Paris.—Since 1877, the Forest Department has been under the Minister of Agriculture, instead of, as formerly, under the Minister of Finance. And the change has proved a most beneficial one; for the forests are now regarded more from the point of view of their utility in augmenting the general prosperity of the country, than from that of the money revenue they can be made to yield; and they are no longer looked upon as available for sale, whenever the low state of the exchequer may seem to suggest this course, which was not seldom in olden days. The Minister of Agriculture is the President, and the Director of the Forest Department is the Vice-President, of a Council of Administration, formed by the eight Inspectors-General, which considers all questions submitted for the orders of Government. The Central office is divided into seven sections, each of which deals with certain branches of the work, and is presided over by an Inspector-in-charge, assisted by two or three other forest officers and a number of clerks.

Ordinary duties in the Forests.—The unit of administrative charge is the division (*inspection*), which is held by an Inspector; but for purposes of executive management this charge is split up into sub-divisions (*cantonments*), under Assistant or Sub-Assistant Inspectors, who are also at the disposal of the Inspector, for any special work that he may require of them. Occasionally, when the division is a small one, the Inspector himself holds charge of a sub-division. The divisions are grouped into Conservatorships, and these again into six circles (*régions*), each of the latter being assigned to an Inspector-General. The forests, State and communal, managed by the Forest Department, are 11,508 square

* Exclusive of two forest officers who have been removed from the active list as professors, and three professors who are not forest officers.

miles in extent, and are divided into 414 sub-divisions, 192 divisions, and 35 Conservatorships; consequently, the average area of each of these charges is as follows, *viz.*:—Sub-division, 28 square miles; division, 60 square miles; Conservatorship, 329 square miles. The average area of an Inspector-General's circle extends over 1,918 square miles.

The sub-divisional officer is essentially an out-of-doors man, who personally directs all work going on within the limits of his charge, in accordance with the instructions given to him by the Inspector, whose assistant he is, and who can, at his discretion, employ him on special duty outside his sub-division. The divisional officer is the manager of the forest estates. He prepares projects for the various works to be undertaken, and directs the subordinate officers in their execution; he is also the prosecutor in all cases taken into Court for the punishment of forest offences. The Conservator exercises a general control over the divisional officers employed under him; it is his duty to see that all work is directed in accordance with the views of the Government, as they are from time to time communicated to him from the Central office. He alone has control of the expenditure, and has power to issue orders on the public treasury. As regards his circle, the Inspector-General is not an administrative officer; but he makes an annual tour, and is required to become personally acquainted with all the work going on, and with the qualifications of all ranks of officers employed within it, seeing that each fulfils his duties properly. During the remainder of the year, he is at head-quarters, where he is able to make use, at the council board, of the information collected during his tour, by advising the Government, both in the issue of orders for works, and in the selection of officers and subordinates for promotion to fill vacancies that may occur.

It may here be mentioned that, in addition to the charge of the State and communal forests, the officers of the Department are called upon to exercise certain functions in private forests, which will be explained hereafter.

Working Plans.—A separate branch of the Department is charged with the framing of working plans for the most important forests; those for the smaller ones being prepared by the local officers. The 35 Inspectors, Assistant and Sub-Assistant Inspectors, thus employed, are divided into 19 sections, which are at present working in 24 Conservatorships. As the operations are concluded in one locality, the section is moved to another. The officers are under the orders of the local Conservator, who transmits their proposals to head-quarters, with his own opinions and recommendations.

Consolidation of Mountain Slopes.—The branch of the Department to which this vast undertaking is entrusted, is presided over by an Inspector-General, and is composed of 76 officers of the superior staff, working in 18 centres. These officers are

placed under the orders of the Conservator within whose charge they are employed ; and he transmits their projects and proposals to the Inspector-General, who is enabled, by exercising his supervision, to utilise the experience gained in each locality for the benefit of the entire work. The Inspector-General reports to the Director of the Department all matters, relating to this undertaking, which are to be laid before the Council of Administration.

Communal Grazing Arrangements.—The five officers employed, in the three great mountain regions, to prepare projects for the control of the communal grazing arrangements, and to arrange the issue of rewards for improvement to the pastures, effected by the *fruitières* (associations for cheese-making), are placed in the same relation to the Conservators as are the officers employed on the consolidation of mountain slopes.

Accounts.—It is a fundamental principle of the French system of forest administration, that forest officers have as little as possible to do with either the receipt or the payment of money. They sell the produce by auction, or by permits, as the case may be ; but the sums realised on account of such sales are paid by the purchasers directly into the public or communal treasury. The Inspector prepares a budget estimate for his proposed expenditure on works ; and when this has been sanctioned, the various undertakings are commenced. Towards the end of each month, he submits to the Conservator an estimate of his proposed expenditure for the following month, during the last days of which that sum is paid to him ; he disburses it at once, transmitting the vouchers, together with the unexpended balance, should there be any, to the Treasurer-General ; he keeps no money in his hands. In exceptional cases, however, the Conservator can grant orders for advances to the officers employed under him ; but in this case, they must, at the end of each month, adjust the advance by vouchers, handed in to the Treasurer-General, along with any balance of cash remaining unexpended in their hands. The Treasurer-General thus keeps all the accounts, both receipts and expenditure, of the Department.

Departmental Staff.

Members of the Forest Department are ineligible for any other office, either administrative or judicial ; they are prohibited from engaging in trade, or in any industry connected with wood, and they must be regularly sworn in before entering upon the exercise of their functions. They have, as regards forest offences, the powers of police, including the right to make domiciliary visits for purposes of investigation, and to arrest suspected persons ; but these powers are exercised chiefly by the members of the subordinate staff. Officers of the superior staff act as Public Prosecutors in forest cases.

Superior Staff.—Candidates for the superior staff are, as a rule, trained at the National Forest School at Nancy; but one-third of the appointments to the lowest grade (*Garde général*) are reserved for the promotion of deserving subordinates. A young forest officer, on leaving the school, is employed for a time, usually about a year, in learning his duties under an Inspector; and his advancement from this probationary stage, as well as his further promotion through the higher grades, depends on his own qualifications and exertions, as reported by his immediate superiors.

A promotion list is drawn out every year by the Council of Administration, and published for general information. On it are inscribed the names of those officers of each grade who are considered to be the most deserving of immediate promotion, the number of names on the list being limited to three times the number of anticipated vacancies. The Minister of Agriculture makes all promotions up to and including the grade of Inspector; but the Conservators, the Inspectors-Generals, and the Director of the Department are nominated by the President of the Republic. No officer can, however, be selected for advancement, whose name is not found on the promotion list, and who has not served at least two years in the lower grade.

The yearly pay of the various grades is as follows:—

Director of the Forest Department, . .	£800
Inspectors-General, 3 Classes, . . .	£480 to £600
Conservators, 4 Classes, ...	£320 to £480
Inspectors, 4 Classes, ...	£160 to £240
Assistant Inspectors, 3 Classes, . . .	£120 to £152
Sub-Assistant Inspectors, 3 Classes, . .	£80 to £104
Sub-Assistant Inspectors on Probation, .	£60

In addition to their salaries, the officers receive travelling allowances, usually a fixed sum per annum, at various rates, according to local circumstances.

A pension, at a rate which varies according to the grade of the retiring officer, is obtainable after the age of 60 years; but no Inspector can become a Conservator after he has passed the age of 55 years. Conservators are usually pensioned at the age of 62, and Inspectors-General at 65.

Subordinate Staff.—All members of the subordinate staff must have served in the army, and, as a general rule, they must have attained the rank of non-commissioned officer; they cannot be less than 25, or more than 35, years of age at the time of their appointment. They receive their first nomination from the Minister of Agriculture, who promotes them from a list, similar to that which is annually prepared for the superior staff. The scale of yearly salaries is as follows, *viz.*:—

Head Guard, 3 Classes, . .	£36 to £44
Guard, 2 Classes, . . .	£28 and £30, with an additional £2 after 15 years' service.

These men must live in or near the forests, where they are provided, as far as possible, with accommodation for themselves and their families, in houses specially built for them; but if such houses are not available, they receive a lodging allowance.

In addition to their pay, they are granted a fixed quantity of firewood per annum, and are allowed to cultivate a plot of ground, not exceeding 2½ acres in extent, also to graze two cows in the forest free of charge.

Each guard has a beat, which he is bound to visit daily; the average size of such charges being about 1,200 to 1,300 acres, or say two square miles. The head guard has four or five guards under his orders; he superintends their work, and communicates to them the instructions of the sub-divisional officer. The duties of the subordinate staff are chiefly protective; they act as forest police, and have power to serve summonses, as well as to arrest delinquents. They are bound to report all offences committed within their beat; and should they fail to do so, become responsible for the payment of any fines or compensation-money to which the offenders may be liable. Acting under the orders of the sub-divisional officer, they superintend all work going on within the limits of their charge; and, in addition, tend the young plants, prune the stems of the reserved trees, fill up small blanks in the forest, and perform such-like minor operations with their own hands. Rewards are given, annually, to men who have specially exerted themselves in this manner; but they are forbidden to accept, without special sanction, any gratuity from "communes" or private proprietors, for services rendered in the course of their duties. They are entitled to a pension when they have attained the age of 55 years, and have completed 25 years' service, including the time spent in the army.

As above stated, one-third of the appointments to the grade of Sub-Assistant Inspector are reserved for the promotion of deserving members of the subordinate staff. Ordinarily, men so promoted must have at least 15 years' service, and be less than 50 years of age; but they can be promoted after four years' service, if they have passed successfully through the secondary school at Barres.

Military Organisation.—Under the law which provides that all men belonging, in time of peace, to regularly organised public services, can, in time of war, be formed into special corps, destined to serve with the active or with the territorial army, the members of the Forest Department form a part of the Military forces of the country; and the officers of the superior and the subordinate staff are organised, by Conservatorships, into companies or sections, according to their numerical strength. In case of the mobilisation of the army, the Forest Corps is at the disposal of the War Minister, and its various units assemble at previously determined points. The students of the Forest

School at Nancy receive military instruction and are drilled, the time passed at the school counting as service with the colours. The officers of the superior staff hold rank as officers of the reserve, or of the territorial army; and in time of war may be employed, either in command of the companies and sections of the Forest Corps, or otherwise, as may be ordered. From the day they are called out, the companies form an integral part of the army, and enjoy the same rights, honours, and rewards as the other troops which compose it. They are inspected by their own officers, annually, in time of peace; and the head-guards and guards, who form the non-commissioned officers and rank and file of the companies, enjoy at all times certain privileges as soldiers.

In virtue of this service, a military uniform is prescribed for all grades, including the students at the schools. The subordinates wear it always; and the officers do so on all ceremonial occasions, including official inspections of the forests by their superiors.

CHAPTER V.

FOREST SCHOOLS.

The Higher School at Nancy.

The Forest School at Nancy is the only one existing in France, for the training of officers of the superior staff. It was founded in 1824. Before that year the Department was recruited, either by means of young men, often of good family, who worked gratuitously in the inspectors' offices, in the hope of ultimately obtaining an appointment, or by means of retired officers of the army. Very few forest officers received, under the old system, a professional training sufficient to enable them to discharge their duties satisfactorily; and it was to remedy this state of things that the school was established. The arrangements were modest at first; but a great development has taken place during the 62 years that have elapsed since 1824. The present organisation of the school will now be briefly described. The controlling and teaching staff is composed as follows, *viz.*:—

1 Director, with the rank of Inspector-General (Professor of Political Economy and Forest Statistics).
1 Deputy-Director (Professor of Forestry).
1 Assistant Professor of Forestry.
1 Inspector of Studies (Professor of Law).
1 Assistant Professor of Law.
1 Professor of Natural History.
1 Assistant Professor of Natural History.
1 Professor of Applied Mathematics.
1 Assistant Professor of Applied Mathematics.

1 Professor of Agriculture.
1 Professor of German.
1 *Professor of Military Science.*
1 Assistant Inspector for Experiments.

All the above are forest officers, except the Professors of Agriculture, German, and Military Science; and none of them, except the Professor of Agriculture, who is Dean of the Faculty of Science at Nancy, have any other duties. The salary of the Director rises from £360 to £480, with £80 a year as sumptuary allowance. The Professors of Forestry, Natural History, Law, and Applied Mathematics receive, on first appointment, £80 a year, in addition to the pay of their grade, whatever it may be; but if, after some years, they desire to be permanently attached to the school, they may be removed from the active list, on a salary rising from £280 to £360 a year, when they are entitled to a higher rate of pension than they could otherwise have received. The assistants take part in the instruction, under the control and guidance of the professors, whom they are in training to succeed; they receive £40 a year, in addition to the pay of their grade. The salaries of the Professors of Agriculture, German, and Military Science are fixed from time to time, the maximum rate being £240. The appointments of Deputy-Director and Inspector of studies do not entitle their holders to any extra pay; but these officers, as well as the Director, have free quarters at the school. The staff is completed with an Accountant, two Adjutants (corresponding to Sergeant-Majors), a Librarian, a Gate-Keeper, and other subordinates.

The Director of the school is the President, and the Professors and Assistants are the members, of a Council of Instruction, which assembles at the school, from time to time, to consider matters brought before it by the Director.

A Council sits at Paris, at least once a year, for the consideration of such general questions as may be brought before it, relative both to the instruction given at the Forest Schools of Nancy and Barres, and the conditions of admission to, and the regulations in force at, those institutions. *President:* the Minister of Agriculture. *Members:* A senator, a member of the *Conseil d' Etat*,* the Director of the Forest Department, the Director of Agriculture, the Director of Agricultural Hydraulics, an Inspector-General of forests, the Directors of the Forest Schools at Nancy and Barres, a Conservator of forests, a retired forest officer, the Director of the Agronomic Institute, a member of the National Agricultural Society, an Inspector-General of mines, a Chief Engineer of naval construction, the Professor of Surveying from the Military School, and an officer of the army.

Admission to the school is obtained by public competition. Candidates must be between the ages of 18 and 22 years; they

* See foot-note p. 401.

must be in sound health, and hold a certificate showing that they have completed their course of general studies at the *Lycée* (High School). The subjects in which they are required to pass at the entrance examination are as follows, *viz.* :—Arithmetic, elementary geometry, algebra, trigonometry, analytical geometry, descriptive geometry, natural philosophy, organic and inorganic chemistry, cosmography, mechanics, the German language, history, physical and political geography, and plan-drawing. But two passed students from the Agronomic Institute, and two from the Polytechnic School, can, if otherwise qualified, be annually selected for admission, without further examination. The number of candidates who enter each year is, as a general rule, from 15 to 18 ; and as the course of study extends over two years, there are from about 30 to 36 regular students at the school at one time. The young men, while at Nancy, are housed in the school building, but take their meals in the town. Their parents deposit £60 a year for their maintenance, including the purchase of books and instruments ; but do not pay anything for their instruction, or towards the annual expenses of the school, which may be estimated as follows, *viz.* :—

Salaries, scholarships, tours, and examinations,	£4,170 0 0
Maintenance of the buildings, library, museum, &c.,	742 0 0
Total annual payments by Government,	£4,912 0 0

If the number of students passed annually through the school be taken as 16½, the actual expenditure per head, for the entire period of two years' residence, is £298 ; but if interest at 4 per cent. on the estimated capital value of the buildings and collections (£22,000) be added, the annual expenditure becomes £5,702, and the amount spent by the State on each student, during the period of his training, is raised to about £350.

Each year of study at the school comprises six and a-half months of theoretical, and two and a-half months of practical, instruction ; one month is occupied by examinations, and there are two months of vacation. During the period devoted to theoretical instruction, the following subjects are taught, *viz.* :—*First year :* Sylviculture in all its branches ; botany, including vegetable anatomy and physiology, as well as the classification of plants and their geographical distribution, special attention being paid to forest trees and shrubs ; political economy, with special reference to forest statistics ; law, including forest laws and rules, together with such general knowledge of the common law of the country as is judged necessary ; surveying and the construction of roads ; the German language ; military science ; riding. *Second year :* Working plans or schemes of forest management ; mineralogy and geology, with special reference to the chemical and physical properties of forest soils ; zoology,

especially that branch of it relating to the insects which attack trees; agriculture; buildings, including houses, saw-mills, and bridges; the treatment of torrent beds, including the construction of masonry and other weirs. The teaching of surveying, law, the German language, military science and riding is continued. During the last month of each theoretical course, weekly excursions are made into the forest; but with the exception of these and the riding-drill, the whole of the instruction is given in the class-rooms.

The practical course, which occupies two and a-half months of each year, or five months in all, consists of tours, made into the forests in the neighbourhood of Nancy, as well as into those of the Vosges and Jura, and occasionally to other localities, for the purpose of studying forestry, natural history, and surveying; but a part of the time is devoted to military exercises. An area of 7,500 acres of forest, situated near Nancy, and placed under the Director of the school, is used as a field of practical instruction, as well as for various experiments and researches, to carry out which an Assistant Inspector is attached to the staff. The subjects dealt with by him are, principally, meteorology, the growing of plants in nurseries, various methods of pruning, the effects of different systems of thinning, the rate of growth of various kinds of trees living under different conditions, and many other things.

The school is well equipped in every way. Besides large buildings to accommodate the Director, the Deputy-Director, the inspector of studies, the students, the adjutants and other subordinates, there is a spacious amphitheatre, with halls of study; a recreation room and an infirmary are also provided. The museum contains very complete collections, illustrating the courses of mineralogy, geology, palæontology and botany, with woods, fruits, seeds, and carefully arranged dried specimens of the foliage and flowers of trees and other plants, as well as raw forest products. There are also stuffed mammals, birds, reptiles, and fish, and a collection of insects, with sections of wood showing the damage done by them to trees. The school possesses an excellent professional library, comprising about 3,350 volumes, and a number of maps. It has also a chemical laboratory, in which many interesting researches are made, either at the instance of the professors, or of forest officers of the ordinary service, who desire the investigation of questions arising in the course of their work. There is a collection of models of saw-mills, of torrent beds treated with weirs, and of sand *dunes*, &c., as well as a fencing-hall and a botanical garden. It is estimated that the buildings are worth about £12,000, and that the library and other collections are worth £10,000; total, £22,000.

The students, having passed out of the school at the end of their course of instruction, are appointed to the Forest Department as *Gardes généraux* (Sub-Assistant Inspectors), and are

employed on special duty for a time, before being entrusted with the charge of a sub-division.

Both Frenchmen and foreigners can obtain permission to follow the courses of the school as "free students," without the payment of any fees. Since the foundation of the school in 1824, 1,334 regular students, candidates for the French Forest Service, have been received; and complete or partial training has been afforded to 239 free students, of whom 30 were Frenchmen, 73 Englishmen, and the remainder foreigners of other countries.

The Englishmen are sent by the Secretary of State for India, to be trained for the Indian Service, under a special arrangement made with the French Government. Ordinarily, free students merely attend the lectures, and, as a matter of course, are not examined; but the English students have to pass all the school examinations.

The Secondary and Primary Schools at Barres.

The Secondary School was established in 1883, in order to train a class of men for an intermediate position between the officers of the superior and those of the subordinate staff. Of the students who entered in that year, 17 passed out as head-guards, and one of these has been promoted to the superior staff as a Sub-Assistant Inspector. But the school was re-organised in 1884; and it is now maintained in order to facilitate the entrance of subordinates into the superior staff, by completing the education of such of them as may be deemed otherwise fitted for advancement. Candidates for admission to the school are selected by the Conservators, from among those of their head-guards and guards who are thought to possess the needful qualifications, and to be capable of passing the required educational tests; ordinarily, they must have completed four years' service in the forests, and be under 35 years of age, but passed students of the Primary School can be admitted after two years' service in the forests. They are subjected to an entrance examination in the following subjects, *viz.*,—dictation, elementary geometry, French history, French geography, timber measurement, the selection and marking of trees to be felled or reserved, and the duties of forest subordinates generally.

The Director of the school is a Conservator of Forests, who receives the pay of his grade and free quarters; he is aided, in the administration and teaching, by two Assistant Inspectors, each of whom receives an allowance of £40 a year, in addition to his pay. Teachers who are not forest officers can be employed when their services are required. As is the case at Nancy, the Director and the professors form a council of instruction and discipline. The students all hold the rank and wear the uniform of a head-guard. They are lodged at the school, and receive an allowance of £2 a month to provide themselves with food and clothing.

The instruction, which extends over two years, is both general and special or technical; the object being to improve the general education of the students, and also to give them such a professional training, theoretical and practical, as may fit them for the position they are to occupy. The course is arranged as follows, *viz.*:—

First Year.—Sylviculture, the cutting up and export of wood, estimates of quantity and value of timber, sales of forest produce, arithmetic and geometry, the elements of algebra and trigonometry, surveying and map-drawing, levelling, forest law, the elements of forest botany (including vegetable anatomy and physiology, and the classification of the principal forest trees), planting and sowing, and geography.

Second Year.—Working plans, buildings and roads, the elements of mineralogy, geology and zoology, the treatment of torrents and *dunes*, forest law and administration, the elements of inorganic chemistry, agriculture and agricultural chemistry, literature and the geography of France.

Most of the above subjects are taught, not only in the class room, but also practically in the forest. The school is established on a property, purchased, before 1873, for the Primary School, from M. Vilmorin, who had raised on it a large number of exotic trees of many kinds. There is also, on the estate, a small forest treated as coppice with standards, which, with the State forest of Montargis, situated at a short distance from the school, is used for the practical instruction of the students. The buildings comprise the residence of the Director, the class rooms and students' quarters, as well as a museum, containing collections to illustrate the various courses of study.

The examinations are conducted before the Director of the Forest Department, or an Inspector General deputed by him for this duty; and the students who pass will, under the new organisation, be appointed to the superior staff as Sub-Assistant Inspectors. Like the officers trained at Nancy, they will be employed for about a year in learning their duties under an Inspector, after which they will become eligible for further promotion, on their merits, as are the other officers of the Department. Subordinates from the communal forests are permitted to pass into the superior grades of the Government service through this school. Nine students entered it during 1884 and 1885, and are still under instruction; eight of them had previously passed through the Primary School. One free student followed the courses for a short time in 1883.

The Primary School is a branch of the establishment at Barres, the instruction being given by the Director and Professors of the Secondary School. It was established in 1878, for the training of young men desirous of entering the service of Government as forest guards, or that of private proprietors as guards or wood managers; and there was at first no restriction

as regards their parentage. Up to the year 1883, 148 students had passed through it into the Government service, and eight of these have since entered the Secondary School. But, in 1884, the Primary School was reorganised; and is now reserved solely for the education of the sons of forest officers and subordinates, who may desire to enter the Government service as forest guards, with a view, in most cases, of ultimately gaining the ranks of the superior staff through the Secondary School.

Candidates must be between 24 and 27 years of age; they must have completed their military service, and be of good character, with a sound constitution. They are obliged to pass an entrance examination in dictation, French composition, arithmetic, elementary geometry, and French history and geography. While at the school, they are styled "Student Guards;" quarters are provided for them, and they receive from Government a part of their uniform, and an allowance of £1 16*s*. a month, to provide themselves with food and clothes.

The course occupies eleven months, and embraces the following subjects, *viz*., arithmetic, plane geometry, algebraical signs, surveying and levelling, the French language, French history and geography, the elements of sylviculture, the elements of forest botany (including vegetable anatomy, physiology, and the classification of the principal forest trees), and the elements of forest law and administration. The instruction is given, partly in the class rooms, and partly in the form of practical work done in the forests.

Passed students are, as vacancies occur, admitted to the Government service as forest guards of the second class; and after two years passed in the forests in that capacity, they become eligible for entrance into the Secondary School. During 1884 and 1885, however, only three students entered the Primary School, two of whom are still there, and one has received his appointment.

Free students can be admitted, with the sanction, in each case, of the Director of the Forest Department; but as yet none have entered the school.

(To be concluded).

(To be concluded).

NOTES ON A FOREST TOUR IN BAVARIA.

THE party consisted of Dr. Schlich, the Inspector General of Forests to the Government of India, Mr. Marshall Ward, Professor of Botany, and four final year's students of the College of Cooper's Hill. The writer joined the party as an unofficial traveller, and during most of the time we were also accompanied by Mr. D'Arcy, Deputy Conservator from the Punjab.

Dr. Grassmann, who has lately been appointed to a forest chair

in the University of Tokio, and who starts for Japan in a few days, was also with us from the 10th to the 16th August.

We left England on the 5th August, and proceeded straight to Munich. On the way, the fine forests of Scotch fir, spruce and other trees near Aschaffenburg attracted attention, and especially the system of treatment of Scotch fir by clear cutting and replanting, a few good and straight standards only being left to afford big timber.

At Munich we spent two most interesting and instructive days in the laboratory and lecture rooms of the Professor of Forest Botany, Dr. R. Hartig, grandson of the well known writer G. L. Hartig, who may probably be looked upon as the chief founder of modern scientific forestry, and son of Dr. Th. Hartig, the botanist. The laboratory occupies a large building at the back of the University, and is most completely provided with every appliance which can be thought of for not only the teaching of forestry, but for the prosecution of original research. One large room is devoted to the diseases of trees, the subject which Professor Hartig has especially made his own, another to destructive insects, a third to forest implements and manufactures, another to microscopial work, &c., and through these we were conducted by Professor Hartig and his assistants. It would be impossible to say much about the very numerous and most interesting subjects on which the Professor entertained us, his clear accounts being rendered in English by Dr. Schlich and Professor Ward. By far the most interesting subject was that of two fungi which attack the wood and bark of trees. We were introduced among other species to the *Agaricus melleus*, which attacks young trees near the roots, and is characterized in its earlier stages by the root-like rhizomorphs which penetrate the soil and communicate the disease to other trees even at several yards' distance. We were shown *Trametes radiciperda*, one of the so-called 'dry rots' distinguished from others such as *Trametes Pini* and *Merulius lacrymans* by the dark spots in the centre of the white patches of soft celluloid tissue into which the wood is converted. Again, *Polyporus vaporarius*, another dry rot, was very interesting, as it may also spread itself from tree to tree or even into houses underground. From the species which attack the wood we proceeded to those which affect the bark, and among these perhaps the most interesting were *Peziza Willkommii*, the fungus of the 'larch disease,' *Nectria ditissima* the canker of the beech, hazel and other hardwoods, and *Peridermium Pini*, which may be recognized as one of the yellow fungi which are so frequently seen on the bark and leaves of coniferæ of the North-West Himalaya.

On this subject of the diseases of trees, in which Professor Hartig has worked for several years with the most important and useful results, the standard work is his 'Lehrbuch der Baumkrankheiten.' To one whose forest studies date back to

1871, the wideness of the subject and its very great importance in forest economy was most startling, and especially so when it is considered what an enormous field practically hitherto unworked lies before the Forest officers who take up the subject in India.

The system of exhibiting wood sections deserves notice. The section is cut into three pieces by cuts through the middle, as ABC, *abc* (*Fig.* 1), and these again are rejoined together by hinges which are let into the wood inside. In this way the sections open like a book of three leaves. One side of the central leaf is usually polished, the other left plain, and thus the specimen shows both the radial and tangential sections of the wood, and the thickness of an ordinary plank.

In the experimental laboratory, Professor Hartig described to us the results of his researches into the comparative value of beechwood of various ages for fuel. These experiments had been made in continuation of those on the wood of the coniferæ which he had already described in his book "Das holz der deutschen nadelholzbaüme." The remarkable results in the case of beech showed that the specific gravity falls off as the tree advances in age, and that the mean of his experiments gave—

Trees	under	30	years,	spec.	gravity	0·76
"	"	30 to 60	"	"	"	0·72
"	"	60 to 90	"	"	"	0·67
"	"	90 to 120	"	"	"	0·64
"	"	120 to 150	"	"	"	0·62

Consequently, there is more substance obtained, *cæteris paribus*, from young woods, than from old; and, if anything, the term of rotation for beech woods grown for fuel requires to be lowered rather than raised. In coniferous woods Professor Hartig has already shown that the contrary result can be expected. One curious fact deduced from his experiments is, that for trees of the same age the wood of canopy trees has the same specific gravity as that of suppressed trees.

On August 10th we visited the forest of Freising, which is used to a great extent as an experimental area and training ground of the higher class forest students of the University of Munich. Here we saw the advantages of underplanting with beech in larch forest, advantages which arose not only from the improved health of the larch from the greater freshness maintained in the soil, but from the improvement in the quality of the wood from the later commencement of spring vegetation and the consequent lesser production of spring and larger production of summer and autumn wood in the annual rings, which of course means a larger proportion of better wood. We also saw the system of regeneration by groups as applied to a mixed forest of spruce, silver and Scotch firs. The group system cer-

tainly has its advantages in improved speedy natural regeneration, but it may be doubted if these advantages are sufficient compensation for the increased difficulty of extraction, and the somewhat complicated system of work, which in India at any rate, it would be rather difficult to apply so as to ensure adequate professional supervision. Professor Hartig, who had been kind enough to accompany us, showed us most interesting cases of the effects of fungi. In one instance, a young Weymouth pine attacked by *Agaricus melleus* at its base, had turned completely yellow, and the rhizomorphs were so fast developing under ground, that not only would the tree itself be killed, but its neighbours for some distance round. Professor Hartig assured us that the only means of combating the pest was to dig a deep ditch at some distance (1 to 2 yards) round the affected tree in the hopes of stopping the rhizomorphs. In a larch wood we saw on a small aspen the *Melampsora Tremulæ*, a fungus which appears as orange coloured patches on the aspen leaves, and whose spores germinate on the larch in alternation, producing the species known as *Cæoma Laricis*. In a silver fir forest we saw *Trichosphæria parasitica*, a fungus which attacks the leaves, causing them to turn brown and fall off.

But the most interesting part of our excursion was our visit to the nurseries and plantations of willow near Oberberghausen. The history of these experiments is very interesting. Formerly nearly all the willow slips for basket work used to be brought to Germany from France and Belgium. Finding the inconvenience of this and its expense, owners began to plant, but soon came to the conclusion that willow growing on a small scale and on good meadow land did not pay, because purchasers would not take the trouble to come and bid for small lots. In order to demonstrate how best the culture might be improved and other lands utilised, as well as which were the best species for the industry, the Bavarian Government purchased an area of some 200 acres, and started a nursery and experimental culture. They have now some 80 acres planted, besides the nursery, and have besides a barking and storing shed, while the results to date are most encouraging. Professor Hartig finds that it is not necessary, as has sometimes been supposed, to plant on wet land, for, provided that the soil is sufficiently worked up he finds the willows to do well even on poor land in high situations, such as that of the excellent plantations we saw at Oberberghausen, where the whole area has been worked up to a depth of about 2¼ to 2½ feet, at a cost of from 125 to 250 shillings per acre according to the nature of the soil. The cuttings are put in in lines 15 to 16 inches apart and 6 inches in the lines, being buried in a slanting direction, so that the top comes beneath the surface of the soil (*Fig.* 2). It is found unnecessary in well-worked soil, to dig holes for the cutting, but instead it is pushed in by means of a small hand implement (*Fig.* 3)

with a hollow in the small end, the larger being held in the hand. The buds are not, as might be supposed, injured in this process, as they stand upwards, and the soil has already been thoroughly loosened. The plantation usually requires weeding the first and second years, and the third year and afterwards it is cut over regularly for the withies, which are then taken to the shed and barked. The stools last usually about 20 years, when the land will be cleared and planted with spruce, other areas being planted with willow instead. In this way the labour of digging out the willow stools will be avoided. The barking is effected by a simple iron instrument with a strong spring (*see Fig.* 4). The withy is put in at A, and drawn sharply down towards B and outwards, two or three draws sufficing to take the bark off cleanly. The peeled rods are then carefully dried in the sun, sorted, and tied into bundles of about 20 lbs. each by the help of a faggot binder. During the drying process it is necessary to be careful that the white withies are not allowed to be exposed to rain or dew, in which cases they would get discoloured and lose value. After drying they are stored for sale. So far, the financial results of the experiment may be thus expressed, roughly, per acre—

Cost of preparation of land,	...	...	£ 12
„ cuttings and planting,	...	...	„ 6
	Total,	...	£ 18

Hence, outlay per year for 20 years $= \frac{£18}{20} = 18s.$ To this must be added the interest on the purchase money of the land, £35, *i.e.*, 28*s*., so that the cost debitable to the plantation is 46*s*. Last year only 36*s*. were realised, for the oldest part being only four years old, only a small amount was cut, and that has not yet reached its maximum yield. It is anticipated that when in full bearing the revenue will amount to 60*s*. per acre at least, giving a clear profit of 14*s*.

In the nursery the Professor showed us the beds in which he had collected the various species and varieties, of which latter there are something like 800. The chief species are *Salix viminalis, purpurea, amygdalina, alba* and *daphnoides*, and of these the best is *amygdalina*, *purpurea* and *daphnoides* being also good. He explained that there are about nine chief points to be considered in choosing a good kind, such as—

1. It should give numerous shoots.
2. The stump should last long, at least 20 years.
3. There should be no, or few, side shoots; and these should easily be taken off.
4. The shoots should be long and slender.
5. They should be flexible.
6. When barked the withy should be white.

7. The wood should be fairly hard, so as not to bruise too easily.
8. The plant should be hardy and not liable to damage by frost.
9. It should not be subject to the willow-disease (this willow disease is the yellow fungus, *Melampsora Hartigii*, which affects the leaves);

and, as already stated, it is found that *Salix amygdalina* is the one which best fulfils most of these conditions. The fungus, it may be stated, affects least those species which have hairy leaves.

On August 12th we all proceeded to Hohenaschau, a pretty summer resort in the Prienthal, somewhat south of the Chiemsee, surrounded by forests chiefly of spruce.

We were located in a handsome inn, the "Burg," which has been lately built. It is in the "Old German" style, and the decorations and furniture are to match. Among other interesting experiences was a concert and dance got up by the peasants of the valley, who sang and played on the guitar and zither, and danced their national dances dressed in their handsome Tyrolese dress.

The chief subject of study in the Hohenaschau forests was the system of hill roads designed to facilitate the export of timber. The forests are the property of a private owner, the Freiherr von Cramer-Klett; and his Forest Manager, Forstmeister Jaeger, was good enough to accompany us through the estate and give us the necessary information. The area of the forests under working is about 15,000 acres, and for this a working plan was drawn up some years ago by Herr von Ganghofer, now head of the Forest Department in Bavaria. The low prices obtainable now for wood have necessitated considerable modifications in the provisions of the plan, for when it is considered that the rates for spruce timber are scarcely higher than $2\frac{1}{2}d.$ to $4d.$ per cubic foot delivered on the railway, it can be understood that only the cheapest systems of working, of utilisation and reproduction, are likely to pay. We could hardly bring ourselves to approve of a system by which what are, practically, clear cuttings were made on steep hillsides at an elevation of 4,000 feet, in narrow vertical strips, to be followed by replanting, and it seemed to us that everywhere where natural reproduction had stepped in, either designedly or by chance, its success was much greater than that of the artificial works. However; the roads were most interesting, especially these by which the timber is sledged out in winter, when the snow makes the work easy and cheap.

In one cutting we saw a hand windlass in use to slip logs over a precipice, while the streams were provided with occasional timber bars to catch the logs and prevent too great a damage to the banks by an undue speed of descent.

On the 15th August a walk in the lower forests drew our attention to two interesting points. The *first* was the complaint made by the Forest Manager that the spruce wood could not be properly regenerated by natural means, owing to the want of seed at the time when the term of rotation (120 years) necessitated its cutting. We were then in a forest of some 70 to 80 years of age, and the trees were remarkably full of cones. It seemed to us that in such a case it would have been better to regenerate earlier, and if necessary keep reserves, thus making his term of rotation coincide with the financial term which usually falls almost simultaneously with the period of greatest recuperative energy. It is all very well for the State to use the longer rotation, for it has other special considerations to take into account tending to the welfare of the country; but for the private owner working on financial grounds only, the earlier rotation and better and easier reproduction is more desirable.

The *second* point was the desirability of frequent revisions of working plans, plainly demonstrated to us by a piece of 90 years spruce, of fine growth and tall stems, capable of giving from 80,000 to 90,000 cubic feet per acre, and apparently quite healthy. When the first working plan was made in 1879 it it had been put in the second period, *i. e.*, that of 72—96 years, the wood being then 83 years old. Since then thinnings had shown that nearly every tree was affected by rot, produced by the fungus *Agaricus melleus*. The Forest Manager informed us that on the revision of the working plan, which is to take place in 1890, the forest will be placed in the first period, so as to come as soon as possible under cutting and regeneration.

From Hohenaschau we went on the 16th August to Traunstein, to visit the fuel depôt and the works which have been erected in order to catch the fuel which is floated down the Traun river and its tributaries. These large works are described at pages 394, 395 of Professor Gayer's "Forstbenutzung," but a short account of them may not be uninteresting here.

During the winter the wood to be floated is collected on the banks of the river near the forests ready for the freshes, which occur when the snow begins to melt in May. Only about six weeks are then usually available for the work, and during that time most of the depôt basins are filled. As soon as everything is ready and the water is high enough, the wood, which is cut into billets of one metre long and about 6 inches in diameter, is thrown in, and finds its way down the river till it meets the slanting barrier which has been constructed across the Traun. This barrier is provided with a stone overflow weir, overtopped by a wooden frame-work, called a 'rechen' or comb, formed of piles with holes in them, in which are passed spruce poles when it is desired to stop wood from passing while allowing the water

to pass freely. The accompanying *Fig.* 5, taken from Professor Gayer's book, gives the plan of the works, which may be roughly thus described?

From the river Traun, which falls at *a*, *b*, through a slanting comb and over a stone overflow weir, the floating channel K leads into a catching basin A. At *m*, *m*, &c., are outlet sluices between thick stone piers, which are closed by sluice gates and combs. At *s s* bends are gratings to let off the water beneath the floating wood. From the catching basin A the wood is passed into the outer basins B and B', from whence it is again led into the stacking basins 1, 2, 3, 4. Should there be more wood than is necessary to fill these, it is passed through B into a channel *s*, and collected in stacking basins 5 and 6 lower down. The water from the outer basins B and B' passes off by gratings into the waste channel *h*, and that from the stacking basins similarly into other waste channels, such as *y*, all flowing back into the Traun.

The wood is then piled up in carefully made stacks and sold. Most of it, however, is taken by the Salt Department, who pay for spruce 3*s*. 9*d*. per stere, and for beech 5*s*. per stere, equivalent to about 9*d*. to 1*s*. per 100 cubic feet stacked, a very low rate compared with even those which obtain in India. The yearly receipts at depôt amount to about 420,000 to 500,000 cubic feet, and the yearly cost of maintenance, including establishment. repairs, and the value of the timber used in the works is £250, With such low rates no other system of transport than that by water would pay, for such long distances as the wood has to come. But at present it is only used for firewood, as it is found preferable to bring out the timber by road. It seems possible that for some of the Himalayan rivers, where the wood which is brought out is light enough to float, such a catching arrangement, or a modification of it, might prove useful and economical. From Traunstein we went south to Ruhpolding, a large village in the Bavarian Alps, the seat of two forest charges; and there we saw the works which had been undertaken in order to improve the banks and bed of the river, and render it fit for floating. These were merely simple strong walls sometimes strengthened with timber and with occasional cross works to prevent the water from undermining them. In a neighbouring valley we also saw where a small lake had had a barrier erected a little below it, so that water could be accumulated and floating carried on even when the regular flow of the stream was deficient. The usual procedure is to close the sluices at night, and let the water collect in a basin above them. In the morning, or as soon as the wood is ready, they are opened, and as the flood escapes the wood is thrown in and finds its way on down to the collecting depôt at Traunstein.

In another valley, named Haargassgraben, we visited, during a rather severe storm, the works which were in progress in a

steep hill stream to prevent damage to its bed and sides in the extraction of timber. For this purpose seven stone work walls had been constructed at intervals across the stream, and the banks improved, the whole at a cost of about £40, the result last year being that no stones whatever crossed the lowest barrier, a satisfactory result, showing how a comparatively small expenditure in suitable works judiciously made may do great good in rendering a stream not only fit for utilization in forest work, but also prevent its carrying destruction into the forests and fields where it reaches the level country or the main valley. Along part of this stream a useful sledge road was in course of construction, the common gradient being from 16° to 20°, and the cost about 4*s.* per yard.

The forests near Ruhpolding were mostly being treated by the selection system, only those on the lower and easier slopes *being treated in compartments usually by the group method*, of which more will be said further on. It was in Ruhpolding that we came across our first case of forest rights and forest privileges, a subject of the greatest interest at the present time to an Indian Forest officer, and especially to one whose chief work during the last eight years has been the selection and settlement of reserved forests. It is some consolation to us at any rate, to know that in other countries than India, do rights and privileges exist, but at the same time it was well to see proofs of how very serious a matter is the proper safeguarding of the rights of Government at a forest settlement. There are instances in Austria, which I may perhaps be able to describe at some future time in these pages, where whole forest districts are worked at a deficit, in consequence of rights which were probably at first granted with no more suspicion of their future consequences than is probably felt by some of those who have, as forest settlement officers, done the same legally or illegally, in India. And in Bavaria it is almost the same, the rights, however, at first obtained, constitute at the present time a serious obstacle to proper forest work. The rights possessed by *various persons over the Government forests are of four principal kinds*—

1. Right to timber,
2. „ to firewood,
3. „ to pasture,
4. „ to litter,

but of course the actual condition of the right and the way in which it is met differ according to locality. At Ruhpolding we met with a case in which 97 farms have a right to timber for housebuilding and fencing and firewood for their own consumption from the Haargassgraben forest, and the supply of this necessitates the giving away free of a considerable portion of the annual yield of the forest. The grazing right is not fixed, though at present when any new regulations of recorded rights

are made, great care is taken to fix the number of cattle. At present the right is not fixed, but limited in the following rather curious way. The regulation is that every inhabitant of certain villages has the right to graze, free of charge, during the summer, as many cattle as he can maintain during the winter by food grown on his own land. The provision is a good one, except that it is extremely difficult to watch, and it is obviously far better to have the right recorded by number. But in order to provide for these rights, the whole of the flat land in the valley, mostly heath land with spruce, has to be permanently given over to pasture, and the appearance of the land is very similar to that of over-grazed forest land in India. And grazing has also to be allowed on the hills, but there the cattle go less. The forest authorities have always full power to close any area for reproduction provided they fence it.

On the 18th August we made a most interesting tour through the forests of Siegsdorf, under the guidance of Forstmeister Hänsolt, and were very much impressed and pleased with the intimate knowledge he had of every corner of his charge, and the really splendid results in natural reproduction which he has obtained from an application of Dr. Gayer's group system, which is of course only a modification of the system of compartments, otherwise of the three cuttings for ensuring regeneration under shelter woods. It has been found that in the application of the three cuttings system, there is often a difficulty after the first cutting has been made, in that the seedlings do not always appear satisfactorily, and then the question arises what to do. In many cases the cuttings have to proceed, and yet there is nothing on the ground. Professor Gayer, therefore, has proposed to utilize spots where an advanced growth of young plants already exists, and to cut gradually around and away from them so as to lead the young growth gradually over the whole area.

Suppose the area shown in *Fig.* 6 to be that set apart for the cuttings of a 30-years' period, and A, A, &c., to be spots on which an advanced growth has appeared, the rings round these spots indicate the gradually widening area from which a portion of the shelter wood is removed for the sake of reproduction. The forest of Siegsdorf is an admirable specimen of the good results obtainable by the system, but there the soil is excellent, the slopes easy, and it is highly probable that the usual plan of a first cutting, followed in turn by the seed cutting and final cutting would have been equally successful. All the time, what has been done, has been done without disturbing the grazing, for in this forest there is a right recorded which gives pasture to about 800 cattle, at the rate of about 12 acres per head.

The greatest care has to be taken to arrange the cuttings so as to avoid damage by grazing, and it seems that under the group system this is less than it would be under the regular three cuttings. The grazing is, however, decreasing, partly by

the increase of the practice of stall feeding, which, by the way, is what one would like to see in India, and partly by the right-holders applying for permission to have their rights commuted.

The area of the Siegsdorf forest is about 10,000 acres, and the annual yield 880,000 cubic feet stacked. The whole of the thinnings, and a considerable proportion of the regular cuttings, go to supply the requirements of right-holders principally in fencing material.

At Reichenhall on the 19th August we were so unlucky as to come in for a very severe storm and heavy rain; but our bad luck was to a great extent compensated by finding the river Saalach in full flood, and a quantity of timber coming down to be caught at the weir.

The catching arrangements at Reichenhall did not very materially differ from those at Traunstein, but there was a large timber depôt in addition to the firewood basins. The timber we saw arriving consisted of a batch of 25,000 spruce logs belonging to a private dealer who had purchased them in the Austrian forests higher up. For the right of using the river for a time, and employing the Government catching apparatus, he had to pay on an average 1*s*. for every five pieces, or £250 for the lot, as well as all the labour employed.

The storm had been a great piece of luck for him, for, as he was allowed only a limited number of days use of the river and works, without it he would have had considerable expense in getting the logs off sand-banks and moving them on when the river was low. The logs were all caught on a grating as usual, and one by one floated off into a side channel ending in another grating, whence they were dragged out to depôt in pairs by horses. It was a fine sight to see the logs borne down the river in full flood, and very interesting to note how easily they were secured and removed.

At Reichenhall we also visited the 'Au-Waldungen' or forests along the river banks growing on land reclaimed from its bed, and gradually rising by silt deposits. At first the growth is chiefly willow and alder, this again is succeeded by spruce of bad quality, which is gradually removed, and valuable hardwoods like the oak, ash and maple planted. Here were some interesting specimens of spruce trees injured by the beetles *Bostrichus typographus* and *Chalcographus*, and a nicely kept nursery surrounded by a hedge of live willow. Most of the poor spruce wood is utilized for the manufacture of paper pulp at a small factory, which the proprietor was good enough to allow us to examine. The process was a purely mechanical one, and spruce the only wood used.

From Reichenhall we went on in pouring rain to Berchtesgaden, and saw another depôt and catching apparatus, and paid an interesting visit to the Salt mines.

On the 22nd we had a glorious day, and spent it amid the

beautiful scenery of the Königsee, where there were several minor matters of forest interest to be seen.

The 23rd August saw the end of our tour in Bavaria. We had a most enjoyable long walk through the forests to the Austrian frontier, and visited the great stone dam across the Almbach valley the Theresien-Klause. This work consisted of a stone structure built across a steep ravine, and furnished with a sluice. The water is collected behind it, and the firewood got ready below. When all is in order the sluice is opened, and as the water leaps out the wood is thrown in and is carried down to be caught again on the road in the main valley below. The dam had an inward curve like an arch to give it strength, and it was about 35 feet high, 65 feet across from side to side at the top and 21 feet broad.

Thus ended a most enjoyable and very interesting tour in Bavaria, to be succeeded by a no less instructive one in the Austrian Salzkammergut, which I may perhaps be permitted to describe in the "Indian Forester" at some early future time.

MUNICH,
2nd September, 1887.

J. S. GAMBLE.

FOREST TECHNICAL TERMS.

Most Forest officers will hail with satisfaction the list of Forest Technical Terms adopted by the Forest Conference of 1886 now issued. It meets a want which has long been felt.

The object of this paper is not to find fault with the list, but to suggest its elaboration, so that it may prove of greater utility. In the opinion of the writer it is a pity that more definitions of the terms have not been given. Some of us understand German, some French, and some neither language; but very few of us have such a perfect knowledge of both languages as to be able to understand technical terms the meanings of which cannot be traced in any dictionary, but must be sought in many and various text-books. In the absence of such definitions it is very probable that some of us may attach meanings to some of the terms, different from the meanings attached to the same terms by others.

A few illustrations will serve to show that this may be the case.

Billet and *cordwood* are both defined as *Knüppelholz*, but the French terms *rondin* and *bois de corde* are different, and it is evident that the terms have a different meaning, but this difference cannot be discovered by the forester who only knows German. The forester who knows neither German nor French is in still greater difficulty. *Knüppelholz* is round firewood having a diameter at the top end of from 3 to 6 inches (7-14 *c.m.*) This term seems to be expressed by *billet*. Will some one furnish us with a definition of *cordwood*.

Wood in the round.—This term requires definition. *Rundholz* is simply round wood, but it is probable that *bois en grume* has a more definite meaning. If firewood, we have already *billet;* if it means timber, would not *post, pole* and *log* be more exact terms?

Brushwood and *fagot* wood are both translated as *Reisholz*. *Reisholz* is firewood under 3 inches in diameter, the larger kinds are sold in stacks or cords, and the smaller in bundles (*Wellen*). What are *menubois* and *bois de fagot?*

Brushwood and *scrub* need definition.

There seems to be no difference between *prune* and *trim*. If no difference is meant, trim might be discarded.

For *sustained yield*, both Heyer and Grebe use *nachhaltiger Ertrag* not *dauernder Ertrag*.

Accessory produce needs definition. In German the *Hauptnutzung* (*principal produce*) is divided into *Haubarkeitsnutzung* (the yield of mature timber), and *Zwischennutzung* (the yield derived from thinnings). The removal of bamboos and inferior wood may be regarded as thinnings, but the removal of fuel and charcoal would often be the yield of *principal produce*.

With regard to the sub-divisions of the working circle, the following information may be useful with respect to German terms. For *Block* the term *Forstort* is now in general use; in Prussia *Block* was formerly used, but so many different meanings have been given to this term by different writers, that it is now generally avoided as having no exact meaning. The *block* is distinguished by a name.

The best term for *compartment* is *Ortsabtheilung*. *Jagen* and *Districte* are the terms used in Prussia. The *Jagen* is applied to the rectangular compartments in the plains, while the irregular compartments in the hills are called *Districte*. In Hanover, Baden, and Bavaria the *compartment* is known as *Abtheilung*. The term *Districte* should not be used for *block*.

Sub-compartment is best translated as *Bestandesabtheilung*. *Abtheilung* is used in Prussia, and *Unterabtheilung* in most other parts of Germany. A *compartment* is denoted by an Arabic numeral, and a *sub-compartment* by a small letter, as prescribed by our own departmental code.

There is a term much needed to supply the place of the German term *Bestand*. This is a portion of a forest which is distinguished from the surrounding forest on account of species, or age, or origin, &c.; or "one homogeneously composed section of forest." It is in fact the unit of sylvicultural treatment. The term occurs many times on almost every page of any German work on Sylviculture, and we seem to have no adequate term to use in its place. Mr. Macgregor in his book "Organisation and Valuation of Forests" uses the word *group*. Can any of the readers of the "Forester" suggest a better term? The term *crop* seems better than *group*, but that has been appropriated for *peuplement*.

P. J. C.

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FORESTRY IN FRANCE.

(*Concluded from page* 501).

CHAPTER VI.

THE PRIVATE WOODS AND FORESTS OF FRANCE.

Those woods and forests which are neither State nor communal property, belong principally to private proprietors, of whom the number is very great; but some are the property of civil, religious, commercial, and other societies. Their extent varies of course from year to year, according as clearances are made for cultivation, or planting work is undertaken. No very exact record of their present area is available; but the latest figures show it to be 23,657 square miles, or about two-thirds of the total wooded surface of France. It is probable that the private woodlands are now being somewhat added to, rather than reduced; for it is believed that the areas annually planted up or sown, exceed in extent those which are cleared. The private forests are not entirely free from State control; while, at the same time, they are protected by legislation in almost the same manner, and to the same extent, as are the State and communal forests. For instance, private owners, in common with the Government and the communes, enjoy the power to free their forests from wood-rights, by making over a portion of the ground to the right-holders in lieu thereof; grazing-rights can only be exercised in those parts of them which are declared by the Forest Department to be out of danger from the entrance of cattle, and the number of animals can be limited, with reference to the supply of grass; while no right can exist to graze sheep or goats in them. Owners have also the power to free their forests of all rights, except those of wood, by the payment of compensation; and, speaking generally, it may be said that

they have the same protection against injury to their property by right-holders, as is enjoyed by the State and the communes. The law also places them in the same position as regards the punishment of forest offences, including trespass by persons carrying cutting tools, cattle-trespass, and the lighting or carrying of fire in or near the forests, with a claim to damages for injury caused. Proprietors can obtain for their forest guards, if they have them regularly sworn in, the same powers for the protection of their property, as are exercised by the State and the communal guards.

On the other hand, private owners cannot cut down and clear their forests, without notifying their intention to do so, at least four months beforehand ; and the Forest Department can, with certain exceptions, successfully oppose the clearance, if the maintenance of the woods is desirable, on any of the following grounds, viz. :—

1st. To protect mountain slopes.
2nd. To protect the soil from erosion, and to prevent encroachments by rivers, streams, or torrents.
3rd. To preserve springs and water-courses.
4th. To protect coasts against erosion by the sea, and against the encroachments of moving sand.
5th. For the defence of the national frontier.
6th. For sanitary reasons.

The Minister of Agriculture decides whether the clearance may be made or not. Between the years 1828 and 1884, sanction has been accorded to the clearing of 1,795 square miles of private woodlands ; but there is no record showing what proportion of this area has actually been cleared, and it is known that sanction is sometimes obtained, merely to give an enhanced value to the property, by the removal of restrictions on it. It is worthy of remark, however, that while the average area of which the clearance was annually authorised, during the whole period above mentioned, amounted to 20,160 acres, the average during the last ten years was 5,404 acres, and during the last five years it was only 3,731 acres. These figures seem to show that woods are acquiring an increased value in France, and that they are cleared for cultivation to a less extent than formerly.

It has already been said that there is a special law relating to the forests of the Maures and Esterel, where fires are systematically lighted in order to get rid of the injurious undergrowth ; and that, under it, private proprietors in those regions are only permitted to light forest fires at certain seasons, while they are compelled to cut fire-lines round all woods not completely cleared of inflammable shrubs. The manner in which the laws relating to the consolidation of mountain slopes, and the planting of the *dunes*, affect private owners, has also been briefly explained in a previous Chapter.

What has already been said regarding the systems of culture generally adopted for the State and communal forests respectively, will lead to the correct conclusion, that those belonging to private owners, are, as a rule, treated as simple coppice, or coppice with standards, private high-forest being usually composed of coniferous trees, and situated in mountainous regions. But many of the forests planted in the plains of the Landes, Salogne, and Champagne, are stocked with coniferous species, which are frequently more suited to local conditions, under which they yield a better revenue than could be derived from other kinds of trees. Notwithstanding that the private forests are, as a rule, more favourably situated than those owned by the State, or by communes, the gross revenue per acre derived from them is considerably less, because the trees, being cut down at a young age, yield a large proportion of timber of a small size and firewood. On the other hand, their capital value is less, and, when they are properly managed, they give a higher rate of interest.

But unfortunately, although there are exceptions to the general rule, and some of the private forests are maintained in an excellent condition, it cannot be said that, generally speaking, they are so; for while coppice, and particularly simple coppice, is exhausting to the soil, from the young age at which the crop is cut and removed, and, in consequence of the comparative frequency with which the ground is denuded, tends to its physical deterioration, working plans are rarely prepared, and there is consequently no guarantee that the cuttings are confined within proper limits. The fellings are, in fact, too frequently, regulated according to the financial requirements of the owner, rather than by the considerations which ought to govern such operations; and hence it follows, that the condition of the private forests is not always such as could be desired. This is found to be the case in all countries; but it is probably especially so in France, where the laws relating to the division of the land on the death of the owner, and the custom of the country, tend constantly to diminish the number of large properties, and to leave in the hands of each proprietor an area of woodland too small to admit of its management on a regular system.

The produce derived from the private forests is, however, large in amount, and of great value. Exact figures are not obtainable; but it is probable that the 26,657 square miles yield annually over 12 million loads (of 50 cubic feet) of wood, with about 270 thousand tons of tanning bark, 2,250 tons of cork bark, and 30 thousand tons of resin—worth, altogether, more than £6,000,000; while the isolated trees and vines yield another 3½ million loads of wood, valued at £1,000,000. The number of foresters and guards employed in these forests is, however, comparatively speaking, very limited; this being due, in a great measure, to the small size of the individual properties, which are consequently, in a large number of cases, man-

aged directly by their owners. There are no private institutions for the training of foresters and woodmen; and although the State Forest Schools are open to receive "free students," but little advantage is taken of this privilege. The Nancy School has only trained thirty such students, since it was established in 1824, and the secondary and primary schools have only received one student between them. Neither the owners, nor their managers and guards, have then, as a rule, had any professional education, notwithstanding that the means of obtaining it is open to them; and it is not to be wondered at if grave mistakes in the management of their forests are of frequent occurrence. In some places, they have the means of getting a certain amount of advice from the State forest officials, who are occasionally permitted to render assistance in this manner; but they frequently attempt to imitate what is being done in the State forests, without knowing the reasons for what they see, and are thus led to commit serious mistakes, as, for example, when, in treating a forest which is to be permanently maintained as coppice with standards, they follow the procedure adopted in a neighbouring State forest, which is undergoing conversion into high-forest. In many cases, of course, the private woods are too distant from the State or communal forests, to permit of their owners obtaining any advice or assistance from the officials of the Forest Department, and they are then thrown entirely on their own resources.

CHAPTER VII.

The Algerian Forests.

The colony of Algeria, which was conquered in 1828, is 162,000 square miles in extent, that is to say, it is about four-fifths of the size of France. It is bounded on the north by the Mediterranean Sea, on the east by Tunis, on the west by Morocco, and it extends southward into the Sahara, down to the 30th degree of latitude. It is divided into three departments, *viz.*, Oran on the west, Algiers in the centre, and Constantine on the east. The population averages only about 21 per square mile, as compared with 181 in France.

The two chains of the Atlas Mountains, which attain a maximum height of about 7,500 feet, run, roughly speaking, parallel to the coast; but they join towards the eastern limit of the territory, enclosing between them the region, about 54,000 square miles in extent, known as the "high plateau," the mean elevation of which ranges from about 2,300 to 3,300 feet. On this tableland are found numerous lakes, called *Chottes*, most of them salt. These are formed by torrents which descend from the ridges on both sides, and are in flood during the rainy sea-

son. The range of hills bounding the plateau to the north, falls away in broken spurs, separated by numerous valleys, to the sea, and forms the fertile and highly cultivated *Tell*, about 70,000 square miles in extent, which is the only part of Algeria where colonies have been established. Here the vine is largely grown, and excellent crops of cereals are raised. The southern slopes of the inner range descend into the Sahara, forming a region, about 38,000 square miles in extent, under the sands of which the water-courses coming from the hills disappear. The desert is marked by *dunes* similar to those of Gascony, but is interspersed with oases which follow the course of the underground streams.

The climate near the coast is much the same as that of Provence, but somewhat hotter. As, however, the ground rises towards the crest of the first range, the temperature becomes cooler, and near the summit the air is moist, while at some seasons clouds lie on the hills and snow falls. The north and north-west winds bring rain, chiefly in the autumn and winter, the annual rainfall in the *Tell* being about 16 inches. The plateau receives less rain, and its distribution is very unequal; while in the desert beyond, the fall does not amount to more than 4 inches a year. The plateau is subject to very sudden changes of temperature, the south winds being burning hot, while those from the north are fresh and even cold; there are sometimes night frosts, even in summer, the daily range of temperature being, occasionally, as much as 70° Fahrenheit.

The forests were formerly much more extensive than they are at present. Abuse of all kinds, following on the first advance of civilisation, has led to the destruction of the greater part of them. Those which remain are found on the upper slopes of the mountain chains, chiefly on the inner ranges, where the absence of roads and other means of export has hitherto rendered them almost inaccessible to wood merchants, while their distance from the cultivated part of the country has protected them from some, at any rate, of the evils that have overtaken the forests in other localities. Some of the principal causes that have brought about the disappearance of a large portion of the Algerian forests, are the following, *viz.*, repeated fires,—the ground is deprived of its natural covering of vegetable mould, and the ashes, resulting from the burning, are washed off the soil by the rain; grazing of goats, sheep, and camels; the native practice of felling young poles, instead of using the saw to cut up the larger trees,—the wood is not only used to supply local requirements, but is converted into charcoal, which, together with bark, is exported in large quantities; the light cover of the Aleppo pine, which occupies a great portion of the ground and does little towards the improvement of the soil; digging-up of the roots of shrubs to obtain bark and firewood; and, finally, the clearing of the trees from land totally unsuited to

cultivation. This last-named practice has led also to this result, that in many places the grass has followed the trees, and the loss of pasture land has in consequence been most serious. It is said that, since the year 1870, the department of Oran has suffered a loss of one-half of its pastoral resources, while the want a sufficient supply of wood is also much felt. Forest fires work terrible destruction in this hot and dry climate, burning up the vegetable *débris*, which would otherwise protect the ground, injuring the larger trees, and destroying the young growth ; but, lately, measures have been undertaken to lessen this evil. It is said that, during the twelve years from 1861 to 1873, nearly 1,000 square miles of forest in the *Tell* were burnt, the damage done having been enormous. Fires are not of such frequent occurrence in the forests overlooking the plateau, where the chief causes of injury consist in overcutting the young trees, and in overgrazing, both of which practices date from time immemorial.

Generally speaking, it may be said that the existing forests clothe the higher portions of the two chains of hills, the ground below and between them being occupied by cultivation in the *Tell*, by pastures on the plateau, and by sand towards the desert. On the high portion of the *Tell*, the forests contain most of the indigenous trees of Provence, including the cork oak, which is the principal tree over a very large area, chiefly in Constantine, and is of great value ; the evergreen oak (*Quercus Ilex*), which yields excellent tanning bark, is common at altitudes above 3,000 feet, chiefly in Oran, while the Aleppo pine covers vast areas in all three departments. Among other trees, also found in Provence, may be mentioned the cluster pine, the ash, the elm, the poplar, and the wild olive. The Zéen oak (*Q. lusitanica*), which is not found in France, occupies a large extent of country, the most important forest of this species being that of Beni Sala, in Constantine. The Thuya (*Callitris quadrivalvis*), a coniferous tree, of which the wood is extremely valuable for cabinet-making, is also found. In localities where the forests have been destroyed, a more or less dense growth of evergreen shrubs of various families, nearly all of them characterised by thick, coriaceous leaves, has sprung up ; and a palm (*Chamærops humilis*) covers a large extent of waste land.

On the hills sloping down to the plateau from the north and south, the most important trees are the Zéen oak and the cedar, the largest forests of the latter kind being those on the Aures, those at Belesma in Constantine, and at Teniel-el-Had, in Algiers. The cedar (*Cedrus atlantica*) forests are usually found at altitudes above 5,000 feet ; but they cannot at present be worked for want of roads. The Aleppo pine, the edible oak (*Quercus Ballota*), the elm, ash, and other trees, are also found in this region. The growth of trees upon the plateau itself is extremely poor, being confined almost entirely to a species of *Zizyphus* and

a *Pistacia;* but immense areas are covered with alpha grass (*Stipa tinacissima*), which is largely used for the manufacture of textiles and paper.

The following is a statement of the forest areas now remaining in Algeria :—

		Square miles.
Managed by the Forest Department—		
State forests, ...	7,604	
Communal forests, ...	300	
		7,904
Not managed by the Forest Department—		
Communal and private forests, ...		1,211
		9,115

This amounts to a little more than $5\frac{1}{2}$ per cent. only, of the total area of the country. The State forests, as well as those belonging to communes and private proprietors, are much cut up by patches of cultivated land ; while about one-half of the area managed by the Department is covered with scrub, and is not worthy of the name of forest. The demarcation of the State forests is making good progress, and, in the department of Algiers, will probably be completed within the next three or four years. The cork oak is the most important tree over an area of about 2,300 square miles, of which one-half is included in the State forests. Above 6,000 tons-weight of cork, valued at £287,700, were exported from Algeria in 1878 ; and 5,940 tons, valued at nearly £290,000, were exported in 1880, chiefly from private forests. The quantity will increase every year, in proportion as the trees in the State forests are gradually prepared for yielding marketable cork, by the removal of their rough, natural, and almost valueless outer coating. The timber cut from the forests does not suffice for local requirements, about £120,000 worth of logs and scantlings being annually imported from Sweden and other northern countries. The preparation of the cork trees in the State forests has not long been commenced, and several years must elapse before they can yield any considerable revenue; hence the gross returns from these forests are at present very small, and are far exceeded by the expenditure on them. Thus, in 1884, the expenditure was over £96,000, while the revenue did not much exceed £25,000 ; the heavy charges were due principally to the treatment of the cork trees, and to demarcation and survey. After a time, however, these forests will pay well ; but the value they have in regulating the water-supply, and in ameliorating the climate, would, even if they had not this prospect before them in the near future, amply justify the expenditure now incurred on them.

It is, of course, most desirable that all denuded areas, unsuited for cultivation, should be reafforested, and some attempts

in this direction have been made ; but the difficulties encountered are great, and the expense of such work is very heavy, while, at the same time, the closing of any portion of the too scanty pastures is strongly opposed by the inhabitants. On the other hand, although the greater part of the water-courses, which are dry during the summer months, become flooded torrents during the rainy season, the results are not nearly so disastrous as those experienced in the Southern Alps ; and, considering all these circumstances, it has now been determined not to undertake the reclamation, on a large scale, of additional areas, but rather to devote all available funds to the improvement of existing forests. What has to be done in this direction is to protect them from fires and from over-grazing, especially by goats, sheep, and camels ; to develop a system of roads and paths, and to build houses for the forest officers and guards ; to stop the practice of felling poles and young trees, and, by the introduction of the saw, to promote the utilisation of large trees ; to plant up blanks within the forest, and to expropriate and stock portions, at any rate, of the cultivated areas within forest limits ; to purchase such private forests as, in the public interest, ought to be under State management ; to regulate the grazing arrangements, improve the pastures, and develop the growth of alpha grass on the plateau ; to introduce a larger proportion of species affording heavy shade, so as to improve the soil ; and to encourage enterprise in the way of forest improvement among private proprietors. These measures will tend to improve the climate, and to regulate the water supply ; and when, some years hence, they have advanced towards completion, it will be possible to commence the formation of new forests. In the meantime, the cultivators of the *Tell* have already done something to counteract the evil effects of the irregular working of the water-courses, by erecting dams, and by constructing tanks, small canals, and other such works ; they have also planted up considerable areas of marsh land with gum trees (chiefly *Eucalyptus globulus*), which have succeeded well so far.

The law of 1881 provides that all laws and rules which obtain in France apply in Algeria, in so far as they are not contrary to local legislation ; but the Governor-General has been invested with special powers, in order to avoid constant reference to the central Government at Paris. Among other local laws there is one, enacted in 1874, relative to forest fires, the principal provisions of which are as follows, *viz.* :—1*st*, No one, not even private proprietors in their own forests, can, between the 1st of July and the 1st of November, light or carry fire out of doors, even for charcoal-burning or the manufacture of tar or resin, either in the interior of the forests, or within two hundred yards of them. 2*nd*, Neither can any one, within the same period, light shrubs, grass, or other vegetation, within two and a-half miles of a forest, without special sanction. 3*rd*, The native

population is compelled to aid in the protection of the forests; and any persons, European or Native, who, when called upon to put out a fire, refuse to assist, are liable to penalties. *4th*, Independently of the penalties incurred by the actual offenders or their accomplices, the tribes can be fined collectively when forest fires are caused by them. *5th*, When such fires appear *to have been lighted intentionally, they can* be considered as resulting from acts of insurrection, and the lands of the offending tribe can be confiscated. *6th*, After a forest, or part of one, has been burnt, right-holders cannot graze their cattle in it for at least six years.

A new law was passed in December 1885, the principal provisions of which are the following, *viz.*:—*1st*, All classes of proprietors can free their forests from rights of all kinds, by payment of compensation, either in the form of land or money: and when estimating the value of such rights, the resources of the right-holders, *on their own property, can* be *taken* into account. *2nd*, Patches of cultivation, or other private lands, enclosed within the State or communal forests, can be expropriated. *3rd*, The proprietors of cork forests, not entirely cleared of shrubs, can be forced to maintain fire-lines round them. *4th*, With certain exceptions, no private proprietor can cut down or bark his trees without sanction. *5th*, With some exceptions, all practices injurious to the forests, are treated under the laws relating to clearances—that is to say, they can be forbidden on certain specified grounds. *6th*, The two last-named provisions of the law apply, *not only to areas covered with trees*, but also, in some cases, to those which grow only scrub. *7th*, Any land which, in the public interest, ought to be afforested, can be expropriated. *8th*, During the period (1st November to 1st July) when the lighting of fires within or near forests is not expressly forbidden by the law of 1874, standing shrubs and grass cannot be burnt anywhere without sanction previously obtained.

The number of forest officers of the superior grades employed in Algeria is 67. The forests of each department form a Conservatorship; but these and the subordinate charges are very much larger than similar charges in France. Their average size is as follows, *viz.*:—Conservatorship, 2,635 square miles; division, 527 square miles; sub-division, 176 square miles; guards' beat, 38 square miles—that is to say, a guard's beat is two-thirds of the size of a French division, the other charges being in proportion.

These areas are too large, but the forests cannot afford a stronger staff at present. Until lately, the Algerian Forest Department was entirely local; but it was found that this arrangement tended to interfere with its efficiency, by impairing the *status of the officers*, and it is now incorporated with the General Forest Service of France.

NOTES ON THE CHINDWIN, UPPER BURMA.

THE Chindwin river is the largest known tributary of the Irrawaddy, and drains an extensive and fertile valley which forms one of the most important districts in Upper Burma. The general course of the Chindwin is from north-east to south-west, being nearly parallel to the Irrawaddy, which it joins in a large delta (if the word may be applied to an *inland* deposit) about 100 miles south of Mandalay. The area drained by the Chindwin, at present under the British Government, is roughly estimated at about 50,000 square miles. But little is known of the resources of the country, and little will be known until specialists have delivered their various verdicts, but to outsiders a brilliant future would seem to be in store for the Chindwin valley. The soil is fertile and grows excellent paddy in places, besides many other grains, its teak forests are amongst the richest in the world, and have been worked for only a few years by the Bombay-Burma Trading Corporation, Limited, who held the leases of the forests from the King. Indigo grows wild in many parts, and, were it not for the high rate of labour, should prove a profitable speculation; the leases to work jade, india rubber, and other products, even now bring in a large revenue; coal appears in many places, and gold dust is collected by the villagers in such quantities that in some outlying villages it forms the ordinary medium of exchange. Add to this that the climate is by no means generally unhealthy, sickness being the exception rather than the rule, and it must be admitted that the Chindwin valley has many elements of success and prosperity.

The soil at the mouth of the river is richly alluvial and produces excellent crops of cereals; for miles and miles the land is perfectly flat and entirely given up to cultivation; the villages are fairly large and numerous, and now that the country is settling down the villagers should see a good time coming.

Seventy miles from the mouth, on the east bank, is Monyua, the principal village of the Lower Chindwin. The rainfall here is estimated at about 18 inches per annum, and the whole country round is cultivated and planted with peas, beans and other dry-soil grains. Six miles higher up is Alôw, the present head quarters of the Chindwin, also an important village. The whole of the Chindwin valley is now under one Deputy Commissioner, but it is shortly to be divided into two, and the head quarters of the Lower Chindwin removed to Monyua, where barracks, jail, hospital, &c., are in course of construction. The width of the river at Alôw is not less than 1,500 yards, but it is shallow in the dry season and not navigable for boats, drawing much over 2 feet; during the rains it forms a magnificent stretch of water, from 20 to 30 feet deep, with a swift current.

The Chindwin had been surveyed roughly for about 400 miles from its mouth, but traders spoke of some falls or cataracts

situated about 100 miles above this, which apparently formed an insurmountable barrier to further navigation. A long-proposed river picnic was organised last July to explore these regions, and the following notes of what we saw and did during this delightful trip may be of interest.

A party—consisting of the Commissioner, Deputy Commissioner, Commandant of Military Police and myself, with a gentleman who was going up to prospect for coal—left Alôw at day-break on July 19th in H. M. T. M. S. "Bhamo." This boat is one built especially for service on the Chindwin; she is a stern-wheeler, draws but 2 feet 6 inches, and can do her 10 knots an hour; the accommodation and food were excellent, and everything conducive to a most enjoyable excursion.

Twenty miles above Alôw is the Shwè-gyi-è whirlpool, so justly dreaded by boatmen during the rains. The river here narrows suddenly and the whole volume of the water rushes through a rocky channel not more than 150 yards wide. The water above the whirlpool sweeps round a bend and breaks on one of the rocky points which form the entrance to the channel; here, during the rains, the water is split in two, one-half dashes through the opening and the other bounding off the rocks forms a whirlpool just above the rocky mouth of the gorge. The depth of the water here must be enormous. On the rocky points guarding the entrance are two small circular pagodas, one gilt and the other silvered; when passing them the boatmen have a custom of throwing into the water, as an offering to the Nats of the whirlpool, a handful of any grain or produce they are carrying.

About 2 P.M. we saw the distant figure of a European officer in uniform on a sandbank making signals to us. This turned out to be one of the officers from Alôw in charge of a small body of men of the Hyderabad Contingent (2nd Infantry) who was co-operating with several other parties in the pursuit of two notorious dacoit "princes." He told us he had just arrived after a march of 15 miles, which had taken him 10 hours to accomplish, going hard all the time over pretty level country. This will give some idea of the fatigue of marching through these almost impenetrable jungles. After giving him a couple of bottles of beer and some sugar (which he assured us was all he wanted), we continued our journey, and at sunset anchored off Mawkadaw, an important trading centre 60 miles above Alôw. Here there is a large police post, thanks to which the people enjoy perfect immunity from dacoits, and are able to pursue their avocations in safety. The principal trade is in wax, honey, fibre, wood oil, resin and dammer, which are brought down from the Mahamyaing forests to the north-east.

20th July.—Off at day-break, and after passing through some uninteresting and scantily populated country, reach Mingin (18 miles) about 9 A.M. Mingin is a sub-divisional head quarters

and a large military post; just below it is the mouth of the Patolon creek, whose head waters drain one of the richest teak forests at present worked by the Corporation. Last year about 6,000 teak logs got jammed in a narrow gut 60 miles from the mouth of the creek, and, with the exception of some 300 or 400 which floated out, were all burnt during the hot weather—a loss of nearly 3 lakhs of rupees. After waiting at Mingin for about two hours to take on firewood we proceeded, our party increased by the Assistant Commissioner.

For the next 50 miles or so the scenery is the finest on the Lower Chindwin; the river, over half a mile broad, winds along between high hills covered with forest growth to the water's edge; anon precipitous cliffs of dark red sandstone rise sheer out of the water throwing deep shadows on the eddies circling around their base.

Forty miles above Mingin is the Pé-Wé whirlpool, which, with its surroundings, forms a most impressive piece of scenery. For nearly a mile the river, here not more than 200 yards broad, winds about between precipitous sandstone cliffs 300 or 400 feet high; the stream is beaten about from side to side and then, as though tired of being the sport of the rocks, settles down into a miniature Charybdis whose waters, apparently revolving on the same spot, meet no obstacle to break their glassy surface. Emerging from the gorge Kalèwa is sighted, pleasingly situated on the top of a small hill, whose feet are bathed on three sides by the waters of the Chindwin and the Kalè stream which unite at this point. The upper reaches of this Kalè stream drain some rich teak forests which, as yet, the Corporation have been unable to work owing to the vicinity of the wild Chin tribes, who live in the hills to the westward, and make frequent raids on the adjoining country.

The territory here belongs to the independent Kalè Sawbwa or Shan Chief, who is friendly to the British rule, and lives at Kalèungo, 30 miles inland from the Chindwin. On the east the Sawbwaship is bounded by the Chindwin, and extends north from Kalèwa for about 25 miles; it contains roughly speaking about 1,000 square miles.

The main Kalè stream rises in the Yaw country and flows north-east, but one of its principal tributaries rises near Manipur and drains the Manipur valley.

21st July.—The whole of this day's run was through the same sort of country—low hills on both banks covered with high tree jungle. On the hill sides were many old clearings, conspicuous in the distance by the total absence of trees and by the undergrowth of bamboos through which show occasional clumps of plantains. From time to time, villages, hidden away in the dense jungle, peep forth from beneath the trees; the pointed gable of a single house being sometimes the only visible portion of a large and prosperous hamlet. Occasionally a collection of

charred house posts bear witness to the raids of dacoit bands. About 2 P.M. we reached Kendat, a large military post, garrisoned (as Alôw and Mingin) by the Hyderabad Contingent. The fort itself is a square, of about 20 acres, surrounded by a strong palisade, 15 to 20 feet high, formed of teak posts planted deep in the ground. At the back of Kendat is a large swamp, now covered in tall grass, which is a favourite resort of water-fowl of all sorts during the cold weather.

As we were anxious to push on as fast as possible, we only stayed to take in firewood, and started again about two hours before sunset, dropping anchor for the night some 10 miles above Kendat, or 160 miles from Alôw.

22nd July.—Forty miles above Kendat is the village of Sitthaung, a military post, defended by 80 Gurkhas of the 44th Assam Light Infantry, under a Native officer. From Sitthaung (which otherwise is a village of no importance) starts the new Public Works road to Manipur, distant about 100 miles as the crow flies; this road for the most part follows an old foot-path by which the mails are now carried. Letters from Calcutta reach the Chindwin by this route in about ten days.

At 4-30 P.M. we reached Paungbyin (70 miles from Kendat) the head-quarters of the Upper Chindwin sub-division, defended by 150 Gurkhas of the 44th A. L. Infantry. The stockade is half a mile from the village, and built on the top of a small but steep hill, up which we climbed. The level ground at the top is very limited, and the hill itself is surrounded by a swamp infested by mosquitos, flies, *et hoc genus omne*. Life here must be dull in the extreme, especially during the rains, but the two officers had to make the best of a bad job. Provisions are very scarce, a limited number of fowls being the only meat procurable, and communication with the Lower Chindwin is almost entirely cut off for six months in the year. The temperature, however, inside the stockade is cool and a punkah seldom required. Whilst playing whist in the evening, on board, we were tortured by a small flying red ant, which, for ferocity and power of causing pain to the human frame, vies with the large red tree ant.

July 23rd.—At day-break we left Paungbyin, taking with us the Assistant Commissioner. About 12 miles to the westward, and apparently running parallel to the river, is an imposing chain of hills forming the watershed between the Chindwin and Kubo valleys. These hills, with their varying lights and shades, their numberless spurs and ravines, and their tiny waterfalls glistening in the sun like streaks of burnished silver, were our constant and daily companions; opposite Paungbyin one point is said to be 3,600 feet, and the range increases in height to over 12,000 feet according to some maps, but we had no means of measuring the heights from the steamer.

Winding onwards through the vast and imposing scenery we

reach Thaungdut (18 miles), the capital of another independent Sawbwaship, and the terminus of the old Burmese road from Manipur and the Kubo valley. Still onward with ever constant speed we glide, the mountains on our left increasing in grandeur, and their summits piercing deeper and deeper into the fleecy clouds, until at 4-30 we reach Homalin (210 miles from Alôw), the most northerly police post on the Chindwin, and anchor for the night.

A few miles below Homalin is the mouth of the Uru creek which we wished to explore on our return. Opposite Homalin the river has narrowed to about 500 yards; the opposite bank is formed by a noble bluff of red sandstone surmounted by a small white pagoda set like a jewel in its surrounding of forest trees, whilst in the background two lofty peaks (5,000 feet and 6,000 feet) rear their stately heads.

Homalin itself is peopled by Shans, but, as a rule, the villagers all understand and speak Burmese. Further north the people are all Shans, but we did not find a single village where Burmese was not understood by the men and boys; they have probably picked this up on their trading excursions, for the weaker sex did not know a single word of any language but their own. Inside the village we came across our first India rubber tree (*Ficus elastica*), a most noble looking specimen nearly 8 feet in girth. The branches bore traces of having been tapped at some former time, but the villagers gave us to understand that there were not sufficient trees in the neighbourhood to repay systematic extraction. The village itself is beautifully shaded with mango, tamarind, jack and other evergreen trees, which are carefully tendered by the Shans; the roads are scrupulously clean, and the houses, which usually boast a small flower garden, are neatly railed off—a very welcome change from the filth of an ordinary Burmese village. What most strikes one in walking through the village is the extreme fertility of the soil, which seems as though it would grow anything. To judge from the vegetation, the rainfall here cannot be less than 150 inches a year.

To all intents and purposes Homalin may be considered the northern limit of the teak and the southern limit of the India rubber on the Chindwin. Teak they say *is* found further north, but only in small isolated groups far away in the hills; on the Uru creek it is very plentiful.

24th July.—As we weighed anchor at day-break the scenery was grand and impressive in the extreme; right in front of us, and apparently barring our passage, was that beautiful and lofty range, every pinnacle of which stood out clear and sharp in the pure morning air. The flakes of snowy clouds still resting on the shoulders and lower spurs of the mountains served but to set off their dark blue colour, and add to their magnificent proportions. There they stood, majestic and serene! rising behind

the low forest-clad hills in the foreground, whose feet in turn were washed by the rippling stream, rose tinted by the morning sun.

At 9 A.M. we reached Kawya, a small village some 16 miles from Homalin, and as we had to stop some time to procure firewood, we took the opportunity of a run on shore. This village is almost entirely given up to the cultivation of tea, and may be considered the southern limit of the tea plant, as far as the Chindwin is concerned. Before planting, the ground is cleared of all undergrowth and low cover, but the high trees (even the densest shade-givers) are left standing. The seedlings, which are usually raised in the house, are planted out in rows at the beginning of the rains, and the first pickings take place when the plant is three or four years old. When the plant gets too big it is cut down, and three or four new stems shoot out from the stool. The leaves are plucked and immediately steeped in boiling water for a short time; they are then taken out, strained, thoroughly kneaded with the hands, and pressed into bamboo baskets, when they are ready for the market, and fetch locally Rs. 4 per 100 lbs. This "pickled tea," as it is called by Europeans ("Lepet" is the Burmese name), is floated down the river in baskets or hollow bamboos, which are carefully kept below the surface of the water to preserve the quality of their contents. Lepet is a favourite dish amongst the Burmans, who mix with it salt, sesamum oil and other ingredients; to the ordinary European its taste is as bad as its smell, which is saying a good deal. There is no doubt as to the adaptability of the soil for tea cultivation, as it grows wild on all the hills, and attains large dimensions; one tree we found neglected in a corner, measured 18 inches in girth at one foot from the ground, and was fully 20 feet high.

Not being able to obtain sufficient firewood at Kawya we steamed on to Maung Kau (7 miles), where we procured as much as we could carry. This firewood had all been previously felled and stored by the order of the Political Agent at Paungbyin, and we always found it cut into lengths and tied up in bundles ready to be brought on board.

In this village we found an enormous rubber tree, which measured 100 yards girth outside its aërial roots; limes, sweet limes, jack, tamarind, *Kanaso* (*Baccaurea sapida*) and other fruit trees were growing in the greatest profusion, whilst ferns of many sorts and countless creepers covered the ground. A tree which seems abundant and attains large dimensions is the *Nyaung-tha-byè* (*Ficus geniculata*). I have seen but few specimens of the old familiar *Ficus indica* on the Chindwin.

Above Kawya the country grows flat and uninteresting, and for miles the banks present a succession of low hills covered with tall elephant grass, and thick scrub, through which an occasional glimpse of the distant mountains can be caught. At dusk we reached Tamanthè, a small village on the west bank, 50 miles above Homalin.

25th July.—Fifteen miles up-stream is the more or less important village of Minsin. Above this point the river was unsurveyed and almost unexplored, so two of us esconced ourselves forward and made a rough survey of the rest of its course with the prismatic compass. 52 miles above Minsin we dropped anchor for the night, having passed but two small villages in the last 30 miles. The river continued its north-east direction with little diminution in its breadth, and the low jungle clad hills for the most part still bounded our view on either bank. Towards evening the scenery became more bold, and a few peaks in the distance gave promise of better things to come, whilst occasional precipitous bluffs relieved the monotony of the near view. The river was not in flood, and the difficulties of navigating so large a boat as ours (160 feet long by 30 feet beam) were considerably diminished; we passed through several small whirlpools which must be almost impracticable when the water is high.

26th July.—The promise of the evening was fulfilled, and for river scenery this last day of our upward journey, as it proved to be, surpassed anything that we had yet seen. In the early morning the mountains on our left in all their grandeur, towered above us apparently not more than 5 or 6 miles distant; the low banks of yesterday gave place to steep and rugged hills some 400 or 500 feet high, whose sides, now clad in deepest green, now peeping forth in abrupt and naked precipice, rose majestically from the water's edge. Hill after hill, crag after crag, succeeded each other in never ending variety of fantastic form till, about 11 A.M., we reached the entrance of a gorge not more than 100 yards wide, and called by the Burmans the "Spirit's gate." For an hour we steamed up this wonderful gorge, our view bounded on every side by the most beautiful scenery of forest and stream that it is possible to imagine. The river, of immense depth, rushing, swirling and eddying along between the rocky banks which, jutting out into the stream like the buttresses of the mighty hills above, formed a series of dark and circling 'pools, each one a miniature whirlpool whose depths reflected back the rocks, the forest and the azure sky above. In front, behind, around, arose in solemn majesty dark masses of virgin forest in all their tropical luxuriance, whose sombre hue was relieved by glistening patches of the beautiful snowy silver tree, and by many a grey and ruddy trunk lit up by the glinting rays of the sun.

The navigation became more and more difficult as we proceeded, and at last it was thought prudent to tie up the steamer, whilst two of us, with the Captain, proceeded in the gig to spy out the land; after two hours' hard work we only managed to advance about two miles, and decided that it was utterly impracticable for the steamer to go any further. Landing for a few minutes on a small bank of sand deposited in a rocky nook, where we picked a few specimens of plants and flowers, we

re-embarked and returned to the steamer. The possibility of actually reaching the "Falls" (said to be only five miles distant) was then discussed and an excursion organised for the following day; but as the gig would only hold three, besides the crew, the seats were given to those who had not yet left the steamer. Not being one of these I can only describe the rest of the journey by hearsay. After the first two hours all idea of rowing had to be given up, and the boat could only be dragged along at a snail's pace by the lascars creeping along the rocks and towing a rope after them. The rocks became more rugged and the channel more narrow as they advanced; in one place an enormous rock rose like a house from the centre of the stream, leaving only a small passage, 30 yards wide on either side, through which the water dashed like a mill-stream. Seven distinct rapids were safely negotiated, and then, after five hours' hard labour, the goal was reached! Rounding a corner the "Falls" were viewed some 300 yards distant, but they proved a sore disappointment to even the least sanguine of the party. There are, in fact, no "Falls" properly so-called, but a succession of three cataracts, of which this was the lowest. The other two we heard were situated within half a mile, but it being as impossible to drag the boat another foot as to go above the cataract by land, a convenient spot was selected on which to enjoy the contents of the tiffin basket and to toast the "1st Cataract." These duties accomplished to every one's satisfaction, the boat was reluctantly started on the return journey, the steamer being reached in safety about 5 P.M.

During the absence of the gig, our time was mainly devoted to the completion of the survey, but towards mid-day we went on shore to explore. We, of course, took our guns, but not a bird or a beast did we see; the hill-side rose right from the water's edge, at an angle of about 45°, and it was with the greatest difficulty that we could force a way through the almost impenetrable jungle. The walking was very hard, and at no time could we see more than 10 feet in any direction; so it is not surprising that, when at length we sat down on a fallen tree to rest, the results of our observations were incommensurate with the amount of energy expended. The species which seemed to form the bulk of the forest growth were :—

Thitkado (*Cedrela Toona*),
Kanaso (*Baccaurea sapida*),
Zimbyun (*Dillenia sp.*),
Thabyè (*Eugenia sp.*),
Maisonlon (unknown),
Mayandaing (unknown),

with occasional Didu (*Bombax Malabaricum*) and Pyimna (*Lagerstrœmia Flos-Reginæ*). The undergrowth was composed of small Betel palms, *Sayo* (unknown), and the terrible *Yon* (unknown). Teak and Pyinkado (*Xylia dolabriformis*) were

entirely wanting. The soil was deep and dark coloured, and resulted from the decomposition of the quartz and basalt rocks which form the subsoil.

The banks of the river are formed of huge blocks of what I took to be basalt, generally slate coloured, but occasionally jet black where they had been polished by the action of the water; running through this basalt are thin bands of snow white quartz. Growing in amongst the rocks, and forming a fringe of vegetation all along the water's edge, are the *Methapan* (unknown) and the *Kaleupan* (unknown).

The country in these upper reaches of the Chindwin are practically uninhabited; in the last 50 miles we had only passed two small villages, but in the evening of this day, we were surprised to see three Kachyins approaching the steamer in a boat; they had heard us firing at an otter during the day and come down to see what was the matter. They did not seem in the least afraid, although they had never before seen a European or a steamer, and they willingly came on board and chatted. We found out they lived in a tiny village of six huts on one of the hills to the west, two hours' journey from the river; they formed part of the Tasan tribe, and their chief lived in a village four days' journey to the west, from which they were cut off during the whole of the rains. From what they told us, it would appear that the cataracts are impassable at all seasons, but that, above the cataracts, the river widens out again, and is navigable for 20 or 25 days' journey in native boats. Above the cataracts are a few Kachyin villages which are self-supporting, and practice taungya cultivation; the country is apparently perfectly quiet, and these Kachyins told us that any one could wander freely about these hills and would be received as a guest wherever he went.

28th July.—A wet, drizzly day, and as we steamed down stream on our return journey, we heartily congratulated ourselves that we had been able to see the defile in all its beauty. We saw a good number of peafowl on the sand banks, and at one place landed to try and get a shot, but they were too alert for us and we returned empty handed. We stopped at several villages to make up our supply of firewood, and were visited by a Sawbwa and his son, who brought presents of fruit, rice, elephant tusks, &c. We anchored for the night near Malin, and the following day (29th) reach Homalin.

30th July.—In the early morning we started down stream, and after about four miles turned eastward up the Uru river. The river at its mouth is not more than 70 yards wide, but becomes both wider and more shallow as you proceed. The banks are low on both sides, and covered with *kaing* grass, a few scrubby trees and wild plantains; where cultivated it gives good crops of paddy as it is inundated every year. Without any incident we reached Maing Kaing (40 miles) about 4 P.M.

and tied up for the night. Here is a large police post, but the village is almost deserted, the villagers having been driven away and their houses burnt by dacoits before the post was established. The old village was situated in a fine grove of India rubber trees, which bore few traces of having been worked; but the country round was flat and covered with elephant grass as before. We went into one deserted *pungyi kyaung*, where we counted no less than 72 most beautiful teak posts; each one perfectly cylindrical, with an average girth of nearly 8 feet, and all 35 to 40 feet long.

31st July.—The mosquitos at Maing Kaing were awful, and swollen faces, a late start and general lassitude throughout the ship the next morning, bore terrible witness to that night of agony. Above Maing Kaing the river is unsurveyed, so our labours with the prismatic compass recommenced, but not for long. The flat country of yesterday gave place to low woody hills and bluffs of red sandstone, the river became more shallow and wound about in a way that severely taxed the powers of our skipper. About ten miles above Main Kaing is the Chaungyi creek, the head waters of which are the present quarters of the Wuntho Sawbwa, and from all accounts, the rallying points for every blackguard in Upper Burma. After four hours' run in all we came to a sand bank, over which we could not force the boat, and it was decided to return; this decision was a great disappointment to all on board, but it was only prudent. The water was slowly falling, and we were afraid of being stranded till the next flood; this would have been fatal, as we were due back to meet the Chief Commissioner in a few days.

The sources of the Uru drain a wonderfully rich country; there are situated the celebrated jade mines, there is the home of the India rubber tree, and there are some of the richest teak forests in the world, as yet practically unworked, and there also the gold dust, above-mentioned, is collected. All these are found on the hills which form the watershed between the Irrawaddy and the Chindwin; and, consequently, part of the produce reaches Rangoon *viâ* Mogaung and Bhamo and part *viâ* the Chindwin. The Uru is almost dry for four months in the year, but during the remaining eight, the navigation is easy for small launches, and there can be no doubt that a few years will produce a wonderful change in the working of these articles of commerce.

The return journey was accomplished without any great difficulty, and we reached Homalin again just after dusk.

1st August.—Gliding swiftly down the stream we reached Thaungdut about mid-day; here a durbar was held by the Commissioner, who invested the Sawbwa with the order of the "Golden chain." Presents of silk and gaudy coloured velvet, &c., were given to the old gentleman, who in return presented an enormous pile of plantains, pine apples, and other fruits,

together with a pair of elephant tusks, and some spears of native manufacture.

Paungbyin was reached before night-fall, and without any further incident the "Bhamo" dropped anchor at Alôw at 10 A.M. on the 4th August.

Here ended one of the pleasantest trips I have ever enjoyed —a 17-days' pic-nic does not often fall to the lot of the Forest officer—and one which all of us, I am sure, will look back to with pleasure.

There is such a feeling of awakening life, of budding civilization in the air; such promise of prosperity and wealth when western resources shall have opened up this fertile, smiling country, for which nature has done so much and man so little, that one is lost in trying to pierce the dim perspective of the future and imagine the Chindwin valley as it will be a century hence.

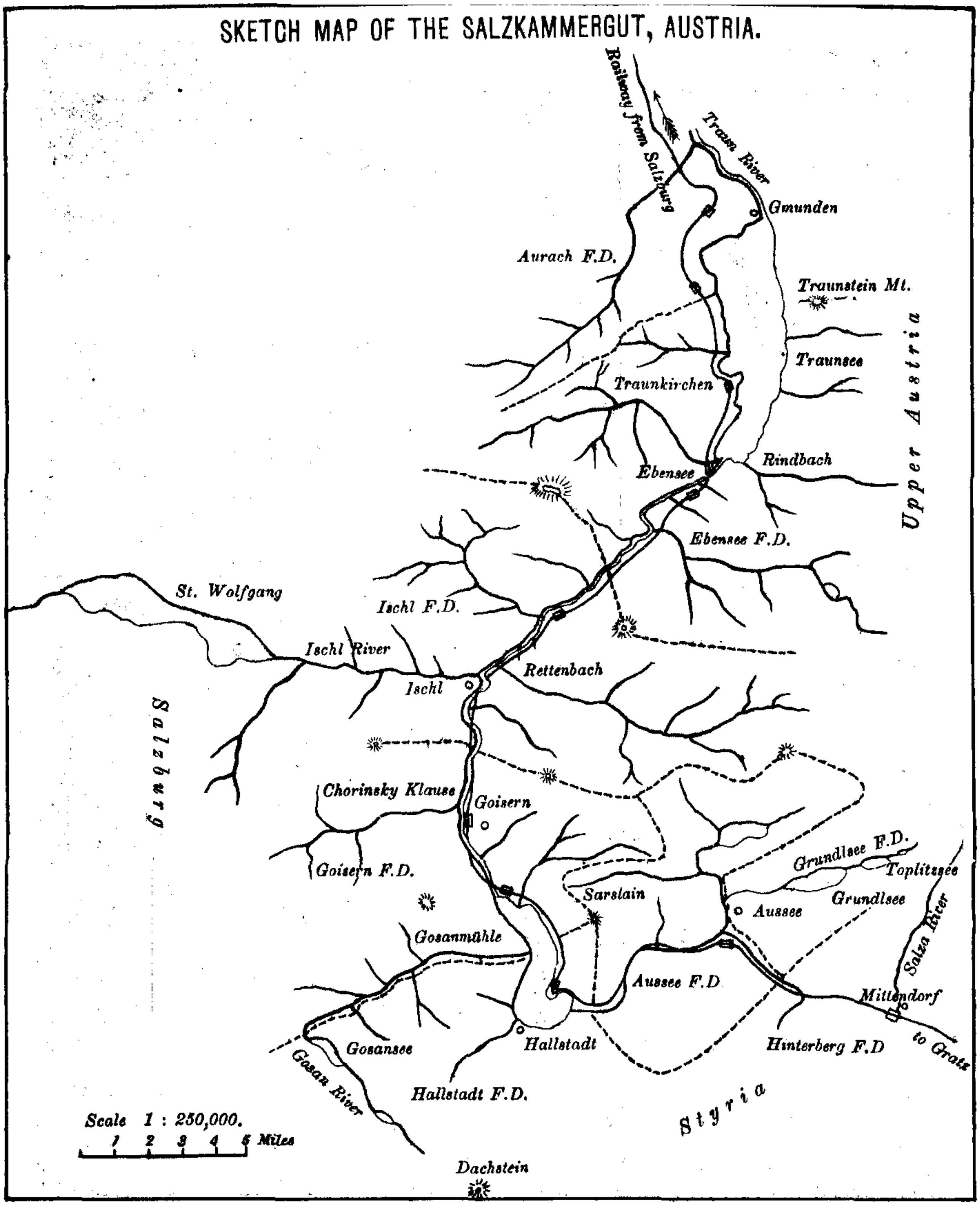
ALOW,
14th August, 1887. H. S.

NOTES ON A TOUR IN THE FORESTS OF THE

NOTES ON A TOUR IN THE FORESTS OF THE AUSTRIAN SALZKAMMERGUT.

In a recent paper in this Journal I gave some account of a tour made with the Forest students of Cooper's Hill College in the forests of Bavaria. I now propose to say something of our subsequent experiences in the Austrian Alps. The party was the same, except that Professor Ward left us after the second day, and the time occupied was from the 24th to the 30th of August.

The Salzkammergut, or 'Salt exchequer property,' is the mountain region lying partly in Upper Austria, partly in Salzburg, partly in Styria, in which are the limestone mountains containing masses of rock salt which are still a large source of the imperial revenue. The chief part consists of the basin of the river Traun, which with its tributaries, especially the Ischl and Gosan, widens out in places into the beautiful lakes known as the Traunsee, Hallstadtsee, St. Wolfgangsee, &c., whose scenery is visited yearly by thousands of tourists. For forest purposes a small portion of Styria on the upper waters of the Salza, a tributary of the Enns, is added to the Traun valley forming the Hinterberg Division. The forest areas which we visited then, were comprised in the Divisions of Aurach, Gmunden, Ebensee, Ischl, Goisern, Hallstadt, Aussee, Grundlsee and Hinterberg, each of which is under the charge of a Forstverwalter. I have attempted to show approximately their situation on the accompanying map. Except that of the Hinterberg Division, the whole of the forest produce of these areas is brought out by the Traun river, and all of it, which is not consumed


SKETCH MAP OF THE SALZKAMMERGUT, AUSTRIA.
Railway from Salzburg
Traun River
Gmunden
Aurach F.D.
Traunstein Mt.
Traunsee
Upper Austria
Traunkirchen
Rindbach
Ebensee
Ebensee F.D.
St. Wolfgang
Ischl F.D.
Ischl River
Rettenbach
Ischl
Salzburg
Chorinsky Klause
Goisern
Goisern F.D.
Grundlsee F.D.
Toplitzsee
Sarstein
Grundlsee
Aussee
Salza River
Gosaumühle
Aussee F.D
Mittendorf
Gosausee
Hallstadt
Hinterberg F.D
to Gratz
Gosau River
Hallstadt F.D.
Styria
Scale 1 : 250,000.
1 2 3 4 5 Miles
Dachstein

either by the salt works at Aussee, Hallstadt, Ischl and Ebensee, or by the public, passes to the open country *viâ* Gmunden. A very large amount, principally converted timber, is taken to Vienna.

In order to facilitate the transport of this forest material, the whole length of the river Traun has been adapted for floating by means of various works, and nearly every tributary is similarly treated, each having a catching 'comb' and depôt where it joins the main river, and the main river itself having large works of the kind at intervals, ending with the fine arrangements to be seen at Ebensee, where the Traun runs into the Traunsee lake. Some of these works for timber transport are among the most interesting and instructive to be seen in any country, and especially so are the great depôt, catching boom and 'combs' at Ebensee, the Chorinsky sluice, the wire rope lift at Gmunden, and the saw-mills at Gosanmühle and Grubegg. The system of sledging roads in the Hinterberg forests deserves study, as does the new carting road from Traunsee up the Rindbach valley. At Ischl itself, the fashionable watering place which forms the central point of the Salzkammergut, can the 'comb' and 'grating' system of wood catching be studied in variety, while throughout the district the forest works are of the most instructive character, showing what great care and pains have been bestowed upon them by the Austrian Forest Staff. In the admirable little forest museum at Gmunden, in the headquarter's office, may be seen models and drawings of nearly all the principal works, as well as complete collections illustrating the flora, fauna, geology, implements and manufactures of the forests. As in Bavaria, we were everywhere received with the greatest kindness, and the local foresters were evidently desirous of sparing no trouble to show us their forests and the works in use for the conversion and transport of timber.

We were able, of course, in one week, to see only a comparatively small portion of the country and the most important works, nevertheless three members of our party managed to find time for a walk over the mountains from Ohladning to Hallstadt, climbing the rocks of the Dachstein (about 9,500 feet) by the help of iron stanchions and by steps cut in the snow and descending over the glaciers. The chief drawback to enjoyment of the Salzkammergut is the expense, for it is quite as expensive as Switzerland; but, doubtless, a single traveller or a pair could, by walking where others drive, and by using the country inns rather than the fashionable hotels, contrive to see even the Salzkammergut as cheaply as they desire.

The forests of these mountains are divided for the purposes of working into four principal kinds :—

1. The high level unproductive country, mostly rocks and steep slopes with but few trees and no system of work.

2. The forests of the steeper and higher slopes, which are uniformly treated on the 'selection' system.
3. Those of the lower and gentler slopes, in which the systems of 'regeneration under shelter woods,' or of clear cuttings, are applied.
4. The litter-producing forests, mostly in or close to the cultivated lands of the valleys, which are treated by lopping for the purpose of supplying the right-holders with litter.

The *first* kind, the unproductive country, is here often little more than bare rock, sometimes even little more than precipice, and in parts goes by the name of the 'Todten Gebirge.' It occupies the highest portions of the mountains, and in places it runs up into glaciers and snow-fields as on the Dachstein, but everywhere the snow must lie very late in the year. The chief vegetation is the mountain pine (*Pinus montana*) with a few Cembro or larch. A few trees may occasionally be planted on slopes which it is desirable to re-clothe, but for the most part the possession of these tracts is left to the chamois, the sportsman and the climber, except where occasional green 'alps' are used for summer pasture.

The *second* kind, the selection forests (Plänterwalder), consist chiefly of spruce, with some larch, beech and silver fir, the latter especially at lower levels. These forests are treated with a rotation of 140 years, and the treatment consists merely in the removal of mature trees here and there yearly up to the fixed annual yield, great care being observed to prevent the formation of blanks with the special object of preventing avalanches and landslips. It is generally recognized that these selection forests, owing to their comparative inaccessibility and the necessity of maintaining permanent shelter, cannot be expected to be very profitable financially, although they require as careful supervision as the areas below them.

The *third* kind, the chief productive forests of the country, treated mostly by the system which is so well known to French students, but which so far has received no simple English name, though it is perhaps best called the 'compartment system,' occupies the lower slopes of the hills especially. The usual species met with in these forests are *first* and foremost the spruce and silver fir, then the larch and beech. The maple, birch, ash and usual hardwoods are found also interpersed where they can find suitable places to come up. The cuttings are of two kinds.

1. Regeneration under shelter woods, with a 100 to 120 years' rotation, chiefly in narrow vertical strips, the first cuttings and seed cuttings being very carefully made, and blanks or a deficiency of the better species being filled artificially at or before the final cutting. In the forests of Goisern we saw some very successful fellings, where the crop produced, consisting of mixed spruce, larch, silver fir, beech and maple, left nothing to

be desired. In this case the reproduction had taken 12 years in all from the strong thinning which formed the preparatory cutting to the final felling of the last of the standards. In this case no artificial planting had been necessary. It is usual to make the preliminary cutting very light, and the seed cutting which succeeds it somewhat stronger, but of course these matters depend on the species grown. In the Salzkammergut it is the larch and spruce which are everywhere favoured mostly, and forest works of sylviculture have to be arranged to suit them.

2. Clear-cutting and replanting. This is often done where the soil is good, the slope gentle, and the saving of time in regeneration is a matter of importance. The cuttings are usually made in narrow vertical strips, and the replanting done horizontally with three to four year old seedlings. Usually about 1,600 to 1,800 plants are put in per acre, and the cost comes on an average to about £1 per acre. We saw some fine pieces of forest planting in the Hinterberg forests, where Oberförster Sieberló had carried out in the most successful manner the re-stocking of a large area, which had for some reason or another been cleared and then neglected. The work had been done at intervals during the last 15 years or so, and the trees planted were larch and spruce with a few Austrian pine (*Pinus Laricio* var. *austriaca*). Most of the restocking had been done with transplants, but there were some areas where sowings had been carried out successfully. We were inclined, however, to think that the transplants gave the most satisfactory results.

The *fourth* kind of forests, the litter-producers, consists of the areas maintained to supply the rights to litter possessed by the old farmers of the valley. These forests are really 'selection' forests and are treated on that system, but their chief use is to supply branch-litter, for which purpose the trees are allowed to be lopped of thin branches up to two-thirds of their number, those below a certain girth being allowed to remain intact. The areas so treated lie mostly in the valley or on very low slopes near to the lands under cultivation, and if, as often happens, the supply of litter from the areas specially reserved for the purpose is insufficient, it is supplemented by leaves and moss collected in other classes of forest.

To show the general distribution of the classes of forest thus described, the Hinterberg Division may be cited. The statistics of that division give approximately—

		Acres.
1.	Unproductive areas, ...	10,070
2.	'Selection' forests, ...	11,250
3.	Compartment forests, ...	12,250
4.	Litter-producing forests, ...	2,750
	Total, ...	36,320

This area is managed by an Oberförster with a Forst Assistent

and 7 Forstwarts, or Forest guards, whose beats have therefore about 5,200 acres each on an average. The annual yield is very nearly 34,200 cubic metres, a large amount, due to the fact that some 60 per cent. of the forests of the division are 100 years old and more. The servitudes which have to be supplied are :—

Wood, 14,100 cubic metres ; litter, 8,000 cubic metres ; pasture for 2,840 cattle and 1,500 sheep.

The pasture is provided throughout the forests, the litter chiefly by the areas specially set apart, and the timber and firewood out of the annual yield, of which the right absorbs no less than 41·2 per cent.

In the Goisern Division, which contains 24,500 acres, of which only 16,750 are capable of treatment, the annual yield comes to 16,700 cubic metres solid, of which no less than 11,200, or 67 per cent., goes to right-holders, so that there is an average yearly deficit to Government of some 10,000 florins.

In the Ischl Division, the annual yield is 18,000 cubic metres, of which some 7,000 are given away in rights.

The origin of these rights dates back to 1740 only, in which year the Empress Maria Theresa accorded to the then householders the right to all the material they require from the State forests. Very luckily, it is only the then existing houses which possess the rights, for Ischl and its neighbours, then mere country villages, have now become towns and fashionable summer resorts, and increased so largely in population, that were the rights held by new comers as well as the old inhabitants, the maintenance of the forests would be well nigh impossible.

The rights are recorded in this way : each old householder possessing a recorded right, is entitled to a definite fixed amount of timber and fuel per house for its use, yearly, under the sole provision that he keeps his house in proper repair. Should he not do so, he would be liable to lose his right ; but, if he prefers it, he may accumulate his right and receive his timber and repair his house every so many years. Or he may even sell, provided that the provision is fully observed. The rightholders have to pay 32 kreuzers for every cubic metre of timber, and 5 kreuzers for every stère of firewood as contribution towards the expense of establishments. This is, of course, but a very small payment compared to the value of the material. The settlement of these rights was made about the year 1862, under special order, and the whole of them were then most carefully defined and recorded, the control books showing in a sort of ledger account with each holder exactly how he stands. The Austrian Government are fortunate in, at any rate, having the rights limited to those to whom they were anciently given, but the story is one which is worth remembering in India, where, quite as much as in Austria or Bavaria, is it necessary that rights should be limited only to those which can be le-

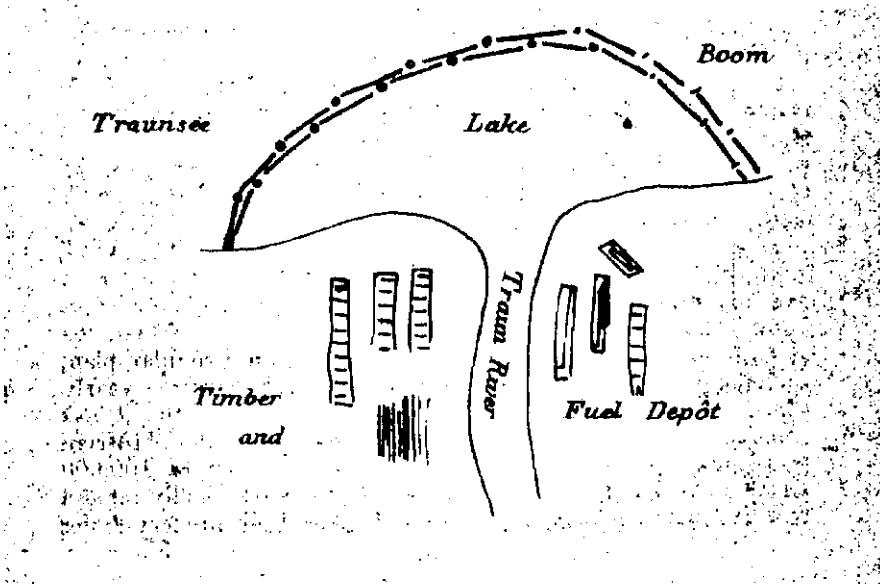
gally proved. In vallies like those of the Salzkammergut, the Government may perhaps be able to resign itself to the assurance that, even if they are working at a deficit, or only just paying their way, they are at any rate making sure of the protection of the hill-sides and of the maintenance of a permanent supply of material. But in India, if the forests do not only pay their expenses, but provide a fair surplus revenue, they are not likely to be maintained when financial crises come; and if the Indian Government and Indian Settlement officers are not careful to see that only rights which are really legal easements against the State are admitted, and to record with the utmost exactitude of limit and definition those which are admitted, the day may come when increase of population and altered circumstances may convert what to the original settlement maker seemed a very paltry concession into a formidable burthen, which may have either to be provided for at a loss to the State, or to be purchased at an extravagant price.

The felling, conversion and transport of the produce of the State forests in Austria is not as in France, carried out by purchasers, but is, with very few exceptions, done by the State. We saw one of these exceptions in the Hinterberg Division, where the forest officers sells in the forest whenever possible the spruce timber cut in the yearly fellings at a rate of about 2 florins per cubic metre, but such cases are rare, and nearly the whole work is usually done by the State. Whether this is good policy or whether the French system, which has been introduced wherever possible in India, of allowing the market to fix rates itself, and restricting forest officers to the growing of timber and not its conversion, is not better, is of course a matter for discussion; but it would seem from the Hinterberg case that the Austrian Government is alive to the benefits of the French style of disposal.

In order to facilitate the transport of timber a most complete system of works of water-engineering was carried out beginning from the very source of the Traun, away down to Ebensee and Gmunden. These consist in works along the bed and banks of the river and its tributaries destined to prevent erosion and facilitate the passage of wood; of sluices at the exits of the lakes and at other intervals to regulate the water-flow or store it in order to economize its use; of 'combs' and catching apparatus, such as I have already described in my Notes on our Tour in Bavaria as in existence at Traunstein in that Kingdom, at each of the chief centres of demand and at the entrances to the lakes; of log booms at these entrances to catch any wood which may be carried through the combs, as well as the logs from the main river; and of other works for the facilitation of transport, such as the 'lift' we saw near Gmunden. Though all these works are still in great use, it is necessary to record that that use is getting, especially as regards *timber*, less and less

every day. It is found that good systems of forest carting roads and timber sledging paths are much preferable; and are so, not only financially, but as preventing the damage and waste of material which always results from water carriage in rocky streams. So that in course of time the elaborate arrangements for water transport may be expected to gradually fall into disuse, and be replaced by land transport through a good system of roads, which not only prove better methods of extraction, but greatly facilitate superintendence and working. As a sample of the excellent forest roads which are in course of construction, may be mentioned that in the Rindbach valley in the Ebensee Division which we visited. The Rindbach valley is a mountain valley covered with spruce forest and with steep sides, very like many similar localities in the Indian mountains, and the road has been carried up on an average gradient of one in eleven or twelve. It is about 10 feet broad, broad enough for one cart, and is metalled to a breadth of about 6 feet 8 inches in the middle and a depth of 8 inches. The cost of the work is expected to vary from £250 to £700 per mile, say, £500 on an average, but it must be remembered that the revetment work is very heavy in places, and that there has been much blasting. The road is an excellent one, and well worthy of a visit from those who have made, or may be called upon to make, similar works in India. We also visited an excellent system of sledging paths in the Hinterberg Division, mostly having a breadth of 6 feet 8 inches with a gentle slope, and costing about £85 per mile. These are, of course, to be used chiefly in winter, when the hardened snow on the ground facilitates sledging.

Of the older works in use for water transport the catching



booms on the lakes, and especially that at Ebensee, were interesting. The boom consists merely of two lines of poles, one within the other, the poles being joined together by chains at the joints. Of course it may happen that in high floods, when much wood comes down, and there is great pressure, some of the wood may be carried under the boom and away, but this does not often occur, and if it does, a boat can easily pick up the pieces in the lake.

Another interesting work was the timber lift at Gmunden, where a double wire tramway lifts trucks laden with firewood up a height of about 200 feet from the valley, by which it has been brought from the forests of the Aurach Division, to a road, whence it can be carted to Gmunden. The wire tramway is worked by water-wheels below, and the whole is enclosed in a long shed up the hill-side. It brings up about 70 to 90 stères a day.

Under the guidance of Forstverwalter Hering, who received us with great kindness and hospitality, we visited the famous Chorinsky Klause in the Weissenbach valley in the Goisern Division. This is the sluice whose works are one of the sights which visitors to Ischl come out to see. The sight, when the sluice is opened and the water is projected forward with great velocity and carries off with it the fuel collected below, is said to be very fine. The sluice itself does not differ very materially from the Theresien Klause which we visited in Bavaria, while its uses and system of work are precisely the same.

The best saw-mill we saw was that at Grubegg in the Hinterberg Division, which contained no less than eight circular saws, one combined upright saw with some 10 to 12 blades, another with two blades on either side for cutting off slabs, another powerful one for cutting big beams, and other arrangements, all worked by a powerful overshot water-wheel. The saw-sharpening machines, very necessary adjuncts when it is considered that each saw has to be sharpened five times in each 48 hours, were interesting to us, and we were pleased to see that they were of English manufacture. At Ischl we saw a simple machine for splitting firewood into small pieces for household use, which might prove a very profitable one in such localities as Chakrata, Darjeeling or the Nilgiris, where Government supplies wood, especially to the Indian Commissariat.

Among minor matters of interest in the Salzkammergut forests may be mentioned the nurseries, several of which we visited, and which we found all maintained on a regular plan, calculated to supply the exact number of plants required yearly for artificial reproduction. At Mittendorf we found the *Pinus Cembra* being grown at the especial desire of the Austrian Government, who have ordered the planting out of 100,000 yearly. It is noticeable that Cembro pine seed usually takes a whole year to germinate. In the Weissenbach nursery *Pinus*

montana and yew for 'reboisement' works were being grown, as well as a Siberian oak (*Quercus macrocarpa*), which appears to thrive.

I may conclude this Note by mentioning, as an instance of the importance attached to the prevention of landslips and of damage to roads and railways, the case of one of the steep rocky hill-sides overlooking the Traunsee lake. This hill-side was once covered with forest, but the forest was burnt by an accident about 20 years ago. As both the railway and the high road lie at the foot of the slope above the lake, it has been considered to be highly important to prevent landslips and avalanches, and so the area has all been carefully replanted, absolutely closed against grazing, and not only against grazing, but against even the wild animals, for a wire fence has been put around it to keep off the deer and chamois, and all shooting absolutely prohibited. All the ravines are protected by barriers to stop avalanches and the fall of stone *débris*, and to allow of vegetation coming up behind them. To an Indian officer accustomed to the terrible havoc which road and railway engineers in India play with the country they traverse, and especially its hill-sides, their complete indifference to what becomes of excavated material, and their frequent desire to clear off every tree and bush along their line, it was very interesting to note the total absence of such unsightliness along the German and Austrian hill railways and roads.

The railway from Ischl to Aussee cannot be very old, and it passes through some exceptionally rocky and difficult country, yet everywhere earth and stone excavated seems to have been utilized for embankments and revetments, and the hill-sides themselves, where cuttings have been unavoidable, are carefully protected by planting bands of willow cuttings, and often seedlings of spruce and larch between. Nowhere is there any trace of the rectangular pits of various sizes which disfigure the sides of all our railways in India; of the awful scars which such lines as the Darjeeling railway have made on the mountain side; or of the forest devastation which may be excellently seen on the Bellary-Kistna. Though scarcely, I believe, 10 years old, the Salzkammergut railway shows none of these marks, but testifies to the minute attention which every portion of the line has received from its engineers, attention which, I have no doubt, will amply repay itself in the saving of money spent on the clearance of slips.

Again, a small circumstance brought to our notice at Ischl very forcibly recalled similar experiences in India. On a rather conspicuous hill near the station a felling of spruce forest had been made in a strip on the hill-side, and the area carefully replanted. Some of the visitors thinking it did not look very pretty, complained that the forest authorities were spoiling the place and cutting forest without any sufficient provision for re-

production. Ischl is to some extent the 'Simla' of Austria, and so the cry ascended to high places, and it ended in the Minister of Agriculture himself making an excursion to the spot with the forest officer, and assuring himself that everything was in proper order. The incident as related was amusing to one who has had some experience of similar complaints in India, and can recall the indignation with which the non-professional visitor regards the making of a seed felling among the Darjeeling oaks, or the thinning out of a dilapidated Nilgiri shola.

I hope your readers will excuse the length of these latter remarks; perhaps they may be uninteresting, and at any rate an Indian Forester travelling in other countries naturally looks most at what there is to be seen which bears upon his work in India, and recalls similar experiences to his mind. After all, I may speak for myself in saying that on the conclusion of my tour I did not find myself so much out of conceit as I had expected, for we have works in India, which though scattered, can compare favourably with anything of the kind in Europe, while forest organization and our sylviculture, though still in their infancy, are progressing with rapid strides. In India, we have usually the great advantage of a quicker growth and speedier reproduction; when we plant it is with some chance that the planting officer may see the results of his work at any rate tolerably well advanced, and in some cases even, as with the Nilgiri eucalyptus, assist at the felling of what he planted, but it is not so in Europe. European experience and practice must, however, continue to guide us in the future as in the past, and for my own part I cannot too strongly thank our Inspector General, Dr. Schlich, for allowing me the chance of seeing so much that is interesting and likely to bear upon my work in India.

August 7th, 1887. J. S. GAMBLE.

EFFECTS OF FIRE PROTECTION ON SAL FORESTS IN OUDH.

The subject of "Effects of Fire Conservancy on Hill Forests" having been warmly discussed in the "Pioneer," I think it may be useful to bring to the notice of your readers a few facts gathered from the Enumeration Surveys in the sál forests of the Kheri Division.

1. The Enumeration Surveys have passed over every compartment of the forest, and therefore data are available showing the standing crop over every one of these. Glancing at the Inspector-General's Oudh Note of 1886, one can see that the closed area can be divided into the following blocks :—

(A), **Not burnt since 1875 inclusive.**
(B), „ „ 1880 „

(C), Not burnt since 1881 inclusive.
(D), „ „ 1883 „
(E), „ „ 1885 „

2. I give below the results of the Enumeration Surveys over these respective areas, taking however only the young stock, *i. e.*, poles of the Vth and IVth Classes (3 to 6 inches diameter and 6 to 12 inches respectively). Below them, for comparison, I give the results of enumeration over the open forest. I should, however, draw attention to the fact that fire-protection was not, in most cases, *begun* in the years above mentioned, but that no fires had occurred since then. This no doubt makes the results for the closed, good as they are, appear worse than they otherwise would; I would also mention that about half of the area surveyed over the open forest belongs to a block which, owing to its situation and soil, is really the most beautifully stocked in the division.*

Year.		Sal.		Asaina.		Superior Kokat.		Inferior Kokat.		Scrub.	
		V.	IV.	V.	IV.	V.	IV.	V.	IV.	V.	IV.
1875,	per acre,	96·720	36·407	2·750	1·982	30·308	12·747	3·357	1·968	25·971	8·228
1880,	„	68·037	28·911	10·487	7·030	17·521	11·821	4·948	8·915	12·223	7·109
1881,	„	46·774	17·175	2·463	2·838	13·400	10·040	4·498	2·303	14·525	7·242
1883,	„	39·992	23·890	8·947	9·951	12·783	9·962	2·388	2·994	12·392	5·945
1885,	„	23·910	17·317	2·337	3·191	11·514	10·049	1·183	1·884	7·532	5·539
Open forest,	„	26·865	20·221	3·817	3·193	7·428	6·980	1·745	2·990	6·999	4·441

3. By adding all the species together we obtain the following Table :—

Year.		V.	IV.
1875, ..	per acre.	159·106	61·321
1880, ..	„	115·396	53·404
1881, ..	„	81·660	39·598
1883, ..	„	76·502	49·813
1885, ..	„	46·494	37·932
Open forest, ..	„	46·853	37·825

The latter Table shows that in spite of a fierce fire which swept over part of the closed forest in 1884, the open forest is hardly better off as regards young growth than this portion, and not so well off as the portion over which a fire passed in 1882.

* See Inspector General's Oudh Note, p. 14, para. 2, Mohan forest.

4. Of course the stock in the Kheri forests does vary very considerably, irrespective of fire protection, but still the benefit can be shown to be considerable by taking each of the above blocks on its own merits and comparing the proportion of IVth to Vth class trees in each of these.

It is evident that under continued fire protection, if it does benefit the stock, the proportion of Vth class to IVth class poles should be greater in the portions which have been protected for some time than in others.

Taking the data we have at hand, therefore, and considering the number of IVth class poles in each respective block as unity, we obtain the following results :—

	IVth.	Vth.
1875, ...	1	2·6
1880, ...	1	2·2
1881, ...	1	2·1
1883, ...	1	1·5
1885, ...	1	1·2
Open forest, ...	1	1·2

Thus it would appear that, in these forests, the proportion of Vth class poles is twice as great in a crop which has been successfully protected for 13 years as in the open forest.

5. Further, sál seems to increase in proportion in the stock with continued fire protection. The following Table seems to bear out the fact :—

	V.		IV.	
	Other species.	Sál.	Other species.	Sál.
1875, ...	1	1·6	1	1·5
1880, ...	1	1·3	1	0·8
1881, ...	1	1·3	1	0·8
1883, ...	1	1·1	1	0·7
1885, ...	1	1·1	1	0·8
Open forest, ...	1	1·3	1	1·1

The results for the open forest compare favourably with the last ones of the closed forest, but we must bear in mind what was mentioned above about the Mohan forest, which, I am happy t[illegible] have since the enumeration, been added to the closed area.

6. Having given the percentagès, it is now worth while to calculate what is the actual increase of young stock due to fire protection. Against the figures so obtained the damage done by the fire in 1884 should be set off, and thus a net increase of stock obtained.

We have five distinct blocks of closed forest, which can be classified as follows :—

					Acres.
(A).	Successfully protected for 12 years before enumeration,				2,248
(B).	"	"	7	"	7,640
(C).	"	"	6	"	866
(D).	"	"	4	"	6,804
(E).	"	"	2	"	15,424

The above are the areas *actually* under sál, all interior blanks having been deducted.

7. From measurements made by Captain Wood in these forests, it has been determined that saplings, which are protected against fire, grow at the rate of four years to the inch of radius, *i.e.*, two years to the inch of diameter.

8. Thus after six years of protection—

(1). All seedlings and saplings which had hitherto been annually burnt down would have become Vth class saplings, and

(2). All existing Vth class would have passed into the IVth class.

After another six years, that is 12 years of protection—

(*a*). The existence of (2) would have been guaranteed.

(*b*). All (1) would have passed into the IVth class, and

(*c*). The process of passing into the Vth class would have been repeated.

Thus in Block A, we may assume that the greater portion of IVth class poles have sprung up since protection, whereas in the other blocks they must already, at the time of closing, have been on the ground in the shape of saplings.

Protection has, no doubt guaranteed their existence and improved their rate of growth.

Regarding Vth class saplings, we may safely assume that, in Blocks A, B and C which have been successfully protected six years or more, all have grown up since protection.

In Block D, the Vth class saplings must already have been on the ground in the shape of saplings and seedlings, which, however, would probably have been partly destroyed had the forest not been protected, and in Block E, in which protection had been attempted for some years before the fire swept through it, the number of Vth class saplings has been brought lower than that in the open forest, which is liable to be burnt every year, but the whole area of which is hardly ever burnt over in one year.

9. Assuming, to satisfy readers of "S."'s class, that the *damage done by fire in 1884, over 15,424 acres, is due to fire* protection, we can counterbalance it by the certain benefit done in Blocks A, B and C and the probable benefit in Block D.

10. I *shall then endeavour* to show that the benefit far outweighs the damage.

Let us return to the Table in para. 3 of this note, and compare the number of Vth class saplings per acre with those of the open forest.

	In Block	A	there is an excess of	112·253	per acre.
	"	B	" "	68·543	"
	"	C	" "	34·807	"
	"	D	" "	29·649	"
and	"	E	" a deficit of	0·359	"

11. By multiplying these figures by the respective areas of the blocks, we obtain the actual increase or falling off in the number of poles. This I have done in the following Table :—

	Block.	Area in acres.	Increase or deficit. Vth Class. Per acre.	For the whole area.
Certain benefit,	A, ...	2,248	+ *112·253*	+ *252,345*
	B, ...	7,640	+ 68·543	+ 523,569
	C, ...	866	+ 34·807	+ 30,142
Total certain benefit, ...				+ 806,056
Loss ...	E, ...	15,424	— 0·359	— 5,537
Balance, ...				+ *800,519*
Probable benefit	D, ...	6,804	+ 29·649	+ 201,722
Total, ...				+ 1,002,241

The area of A, B and C taken together is only 10,754 acres, and yet the increase in these *far outweighs the damage done* in the larger area E.

12. I have confined myself to actual figures, but were I to add an *estimate of the number* of IVth class poles in Block A, and of the innumerable seedlings and saplings less than 3 inches in diameter which spring up all over the closed forest, the benefit derived from fire protection would be shown to be still greater.

13. It would be interesting to see whether the Enumeration Surveys in the Dún, Jaunsar, &c., give similar results.

It would be worth while to make *enumerations of the young*

5 C

stock, say every other year, in portions which have been burnt since the survey. Thus, in the long run, reliable data could be obtained as to the length of time required, in each locality, for a forest to recover from the effects of a fire as regards young growth.

14. In Oudh a certain number of men have been trained as Recorders and Gaugemen, who would be able, at a moment's notice, to do the enumeration of any portion of forest in the Circle.

A. F. BROUN.

THE FOREST QUESTION IN AUSTRALIA.

THE Colonies are gradually awaking to the fact that their forests constitute a property worth preserving. The old, old story repeats itself here as elsewhere—valuable woods for years treated as rubbish to be destroyed by every possible means, and then suddenly a startled enquiry as to why timber is scarce and whether a reduction of forest area is prejudicial to climate.

South Australia deserves the credit of being the first colony which undertook anything like systematic treatment of its woodlands, and it is now some years since its forest property was placed under the administration of Mr. J. E. Brown, Conservator of Forests at Adelaide. South Australia is, however, unfortunate in not possessing the same wealth of timber as other portions of the great island-continent, and more work has been done in creating artificial forests than in tending natural ones already existent.

New South Wales and Victoria have long possessed a staff of officials—variously known as Rangers, Foresters, Forest Inspectors, &c.—belonging to the Department of Crown Lands, whose chief duties are to collect payment on timber or to limit the ringing of trees on areas leased for pasture. But no really efficient forest protection of any kind has hitherto been established, and the system referred to is crude in the extreme.

The huge tract of Western Australia is heavily timbered throughout a considerable area of its south-west portion, lying, roughly between Perth and Albany. Here is the home of the celebrated "Jarra" (*Eucalyptus marginata*), and "Karri" trees (*Eucalyptus diversicolor*), the wood of the former being second only to teak for ship-building and submarine constructions. Several Timber Companies have obtained leases from the Government, and have now for years been occupied in this region cutting out the more valuable wood, which is railed down to the sea on trams and shipped to distant parts of the world. It will perhaps surprise Indian readers to learn that much sandal-wood (*Santalum cygnorum*) is exported from Western Australia, the demand even in Ceylon being partly satisfied from this source.

No system of forest conservation on the part of the State is as yet in force, though a report on the timber resources of the country was drawn up a few years ago, with a careful description of the principal timber trees added by Baron F. von Müller.

From the above it will be seen that in almost all the colonies forest areas have, up to the present time, been regarded as little else than mere waste land. When we consider that Australia is by nature a very well wooded country, and that these settlements are all comparatively—some very—recent, it is of course only natural that such should be the case. In the first instance the new settlers were obliged to clear the country in order to get space for pastoral and agricultural operations. So long as the soil thus cleared was well suited for the purpose and at the same time the essential proportion of wooded, as compared with open, land was not too much reduced, a distinct improvement and increase of public wealth was the result. But there soon came a time when the progress in the direction of wood-destruction became too great. Squatters, anxious to enlarge their runs or to take up new ones, blindly set to ringing trees over soil unsuited to furnish a heavy feed for sheep, deluded by the strong crop of grass which immediately sprung up after the removal of the cover, only to thin itself out as the humus of the soil, after exposure, became burnt up and washed away.

In Victoria, Baron von Müller many years ago, in lectures, pamphlets and essays, raised a warning voice that things were already going too far. But time alone could bring the question prominently to the front. In the early days of a vigorous, pushing, young community, every man was occupied in an absorbing struggle for wealth. The discovery of the Ballarat gold-fields added to this feeling, and hastened the destruction of a fine forest district. As society became more settled, and no doubt a good deal owing to Baron von Müller's persevering efforts, public attention was gradually attracted to the fact that Melbourne imported large quantities of timber—some even from Europe—and that not only was there a dearth of wood at the capital, but that Ballarat and Sandhurst no longer found it so easy as formerly to supply the great demand for mine-props and fuel. The matter was brought to the notice of Government, but shelved by several ministries in succession until public opinion began to clamour. Things came to a head, and the present Minister of Lands has promised to place a suggestion before the House during the next session of Parliament.

The Victorian forests have suffered, much valuable woodland has been absolutely cleared or hopelessly ruined, but much still remains. The moist hilly country of the Australian Alps and Gippsland, in the south-east of the Colony, yet contains large areas of fine forest at no great distance from the coast and crossed by railways. The same may be said of the Cape Otway district to the south-west, while skilful treatment may still

restore eucalyptus copses for the supply of Ballarat and Sandhurst. The great prevailing idea—this, too, largely on account of Baron von Müller's teachings—is to introduce exotic trees and have recourse to plantations on a grand scale. Australia is very poorly provided with native conifers and absolutely without a single indigenous pine, so that a few of these "soft-woods" might advantageously be introduced. But, on the whole, the colonists will find it more profitable to take what nature has already provided and make the most of it, rather than endeavour to replace their really excellent native timbers by exotics whose success must always be more or less problematical. At the present time a Royal Commission on vegetable products is sitting at Melbourne engaged in taking evidence from experts as to the future prospects of all industries which employ vegetable materials, and as to the resources of the Colony in this respect. In this way some evidence has been given regarding past experiments in the introduction of exotic timber-trees, but it is doubtful whether the practical results of the enquiry will be very great as far as forestry is concerned.

Victoria, then, has arrived at the determination to take up the question of forest conservation and form a Forest Department for the purpose of preserving and scientifically working the woodlands of the Colony. It is to be hoped that this administration—on whatever form it may eventually be moulded—will be given a thoroughly sound basis. In the first place the department will have to be kept entirely free from all political or other external influences, so that it may have its hands completely at liberty for the exercise of its functions in whatever way it may honestly judge to be best for the public property committed to its charge. The Government itself is in the most favorable position for deciding the knotty question as to what form of administration will best fulfil these conditions. The Department, however, while of course remaining answerable to some member of the Ministry, should be entirely disconnected with the Department of Crown Lands.*

In the next place the department must be supported by some legislative measure, such as a Forest Act, which will give it a legal basis from which to work. The India, Burma and Madras Forest Acts would form good models in all essential points, and little more than a mere modification of details would suit them to the requirements of Australia. In treating of the formation of any estates of the nature of reserved forests, the law in the Colonies should provide specially that these forests be inalienable and can have no portion of their area cleared, without the consent of such authority as shall render impossible

* The Department of Crown Lands deals with grants of land to settlers and with other allied matters. Its functions would be liable to clash with forest policy, and under political pressure abuses might arise.

the pressure of undue influences. And here the formalities of procedure would be greatly simplified, owing to the fact that "adverse rights" are unknown, the forests being merely crown lands which have not yet been taken up by settlers. Among forest offences specially punishable by the Act, incendiarism or careless use of fire within or near forest limits would need particular mention, although such actions on any land have already been declared criminal by a law previously in force.

Finally, Victoria will do well to profit by the experience of other countries in the choice of its servants for forest work. No doubt it will do so, and follow the example set by the Cape Colony in obtaining the assistance of trained men of experience for directing its forest operations in the first place. The popular idea in Australia is that an annual allowance will have to be made in the National budget to provide for the expense of preserving her forests from further harm, and that if a Forest Department could reduce this allowance to zero, there would be every reason for satisfaction. Those who have watched the progress of Indian forestry during the last fifteen or twenty years will understood how very modest an expectation this is. Perhaps it would be as well to undertake things gradually at the beginning, but once started on sound lines the work will be sure to progress by strides, and the revenue realized will soon be enough to give work for more guiding heads and working hands. The income of the Department will swell, and the establishment must, for some time, increase with it. The Victorian Government should fully realise this, and the necessity that exists for having some source on which to draw for the necessary supplies of men. Luckily the forest training at Cooper's Hill, whence India is provided with young officers, exactly supplies the want felt. Without special training it is hopeless to expect the best work, and there is little doubt the Colonists intend to have the best possible work out of men to whom their forests will be entrusted. It is a long journey to the old country, but the Government should not mind the expense—after all, not very great—in order to obtain really good officers, since on their efficiency depends the whole success or failure of the forest policy of the country. And here it may be remarked that proper training for the subordinates serving under these officers is an immense advantage which should be kept in mind. In Victoria the essential success of forest operations will largely depend on the class of men chosen for managing the ultimate units into which wooded estates must be divided. These officials would correspond nearly to Rangers in India, where the necessity for scientifically training men in such positions has been recognised. Perhaps eventually arrangements will be made for training candidates for these posts in sylviculture, chemistry, botany, &c., at the Agricultural School at Dookie, but this will scarcely be possible for some years yet.

The progress of forestry in Australia will be watched with interest in India, and many problems will doubtless have fresh light thrown on them by the peculiar conditions obtaining in the colonies. The question of cheap fire-conservancy in a hot, dry climate, where workmen's wages vary between six and eight shillings a day is a case in point.

R. E. D.

FOREST TECHNICAL TERMS.

A LIST of Forest Technical Terms as adopted by the Forest Conference held at Dehra Dun in October 1886 has been supplied to Forest officers for use in official correspondence, &c., and I would venture to remark that the list might with considerable advantage be revised in several respects.

(*a*). The headings of the columns might possibly appear more appropriate if arranged thus—(1) Technical Terms, (2) French, (3) German, (4) Definitions and Explanations.

(*b*). A fuller and more complete list might be provided. The following terms not in uncommon use have been omitted, and might find a place. "Reboisement," "Defensable," "Fire-trace," "Differentiation," "Forest round," "Round-guard." Some of these possibly are used in one or two Circles only in this country.

(*c*). Though French and German terms have been given against many of the so-called "English terms," still in the column "Definitions and Remarks" a great number of the terms are not explained, and I do not think that all the undefined terms are self-suggestive of the meaning attaching to them.

(*d*). Some of the definitions now given may possibly be improved upon, for example—

(1). "*Advance growth.*" I take exception to the meaning given, and hesitate to believe that "a seedling crop," or "thicket," as defined, will be discovered under a complete stock of trees.

(2). "*Couvert*" to my point of view applies to the *forest* and not to the *treatment*. The conversion is the result of the changed treatment.

(3). "*Clump*" has other meaning besides the aggregate of stems issuing from the same root or stool.

(4). "*Coupe*" does not, in my appreciation of the term, signify *the operation* of felling over a given area. It is a noun and not an ac-

tive verb, and is used more generally to mean the area of a particular or specified felling in the past, present or future, or in other words, a specified area that has been cut, is being cut, or is to be cut hereafter.

(5). "*Coupe, location of*" is not correctly defined by "the area felled or to be felled over." The determination, selection, definition or fixation of the area of a specified felling of the past, obtaining now, or to be made hereafter, may be a more accurate interpretation.

(6). "*Coupe, map of.*" No definition has been given, but the term of itself shows that the meanings given to "Coupe" and "Coupe, location of" are somewhat erratic.

(7). "*Cut back.*" Is the operation of cutting flush with the ground a young seedling or shoot, and not of felling flush with the ground a large tree as the definition given would imply.

(8). "*Dibble.*" The meaning does not possibly go far enough.

(9). "*Exploit, Exploitable, Exploitability, Exploitation,*" The definitions given to these terms might possibly benefit by a further consideration of their application.

(10). "*Increment of growth*" would seem to me to point to the increase of timber, or the wood put on during the year rather than the additional growth of the tree during the year in height or spread of branches.

The definitions given in Appendix B are some of them far fetched; simpler and clearer explanations would be more instructive and intelligible, especially to the unprofessional, for the list has been supplied to Collectors of Districts as well as to Forest officers for official use.

FORESTS.

COMPOUNDING FOREST OFFENCES.

A GOOD deal might be written on both sides of this question, and I should therefore like to join sides with "A. J. C." against "Ghati." In the first place I would like to point out to your readers that it is not a Forest officer's special line "to work up the case so as to secure a conviction before a Magistrate," whilst it also seems far preferable to allow an offender to compound

than to prosecute him in a Magistrate's court, bearing in mind, that in most forest districts men of the jungly class have to be dealt with. The one great reason that I have for supporting the power given in Section 67 is, that by compounding I am enabled to keep my foresters and guards from running to court, which is to them a most convenient plea for leaving their forest station and going into a more civilised part. If there is black-mail to be levied by compounding, I should like to know if there is not much more to be gained by the Forest subordinates in letting off the offender when he comes into court and has the pleader's persuasive voice to deal with!

I fully grant that Section 67 requires very careful handling as it may become "a curse instead of a blessing," but with Conservators who know their men, it is not in the least likely that they will grant powers to compound, unless they are confident that such powers will not be abused.

Speaking for myself, I never allow my subordinates to compound for more than double the value of the damage done or property effected, except in the case of illicit grazing or setting fire to a forest, and in such cases I have to be more severe: whilst under no circumstance will I allow an offender to compound for a second offence. He must then go to court.

It should also be borne in mind that many forest offences do not deserve the infliction of imprisonment, and also that it is a very great hardship to take a man to court for taking bamboos, grass and other minor produce which probably he was in the habit of cutting freely when he was younger but which has now been stopped. I fully admit that he generally knows that he has done wrong, and therefore should be made to pay rather heavily for what he has taken; but it hardly seems right to prosecute him, which often entails his dancing attendance in court for days, besides having to go backward and forward to and from his home to obtain witnesses and possibly in the end being imprisoned?

Finally, it is not in the least necessary for "Ghati" or any other officer to take advantage of Section 67, as all offences can be taken into court, should the Forest officer concerned think it preferable to prosecute instead of compounding.

For my own part (and in this I think that many of my brother officers will agree with me) compounding forest offences is far preferable to prosecuting the unfortunate offenders.

RANCHI.

COMPOUNDING FOREST OFFENCES.

I WAS not intending to reply to the remarks of "Ghati" on the above subjects, as his experience of Indian forests must be vastly different to mine and that of most Foresters, but I notice

in page 441 of the October "Forester," that in France in the year 1859, "a law was passed which enabled the Forest Department to take compensation from offenders, instead of bringing them before the tribunals, this method of dealing with them is now *largely* practised." After such long experience, the French officials did not find that the practise of "compounding offences" was a curse, *instead of a blessing*, as "Ghati" would have us believe; and if this practise has proved necessary and beneficial in dealing with cases in the well protected forests of France, then, *à fortiori*, is it necessary in India, where, as a rule, the forest protective staff is weak and inadequate; and where also a very large proportion of the forest areas is not, and will never, be fit for growing large timber, but at the same time these areas are very valuable for grazing, grass, fuel and small wood—all most important considerations for the vast poor population of India?

Perhaps "Ghati" does not know how to work the Section to which he refers, and which he would like to see expunged.

17*th October*, 1887. A. J. C.

REPRODUCTION OF BAMBOOS.

I HAVE from time to time seen several hints and criticisms published in the "Indian Forester," but have never found a definite rule laid down for the guidance of beginners on the cutting and cultivation of bamboos, save to study "Nature."

Being a novice, I wish to say a word or two about bamboos, while hoping for advice from experienced officers of the Department through the medium of this Journal.

1*st*. No new clumps should be cut which have not attained 25 bamboos, or, as I reckon it, under 7 years' growth, (not from seed, but rhizome shoots.)

2*nd*. The clump containing 25 bamboos, of 7 inches in girth, should not lose more than 8 bamboos yearly.

3*rd*. Thus clumps forming 25 to 30 culms can bear removal of 8 to 10 bamboos annually with advantage, and above this number average growth per clump per year must first be estimated.

4*th*. No bamboos should be cut lower than 2½ feet, or three nodes from the ground.

5*th*. No bamboo should be cut under 3 years old, unless one wishes to kill the clump outright, then take the first year's shoots, which are easily recognizable, as they exhale soap-like froth when cut down, and you may depend the destruction is not far off.

6*th*. No dry stool or bamboos should be allowed to remain in the clump.

7*th*. And last, the most difficult point, but a secret of success; do not touch the clumps during the reproduction season,

which is from 15th June to 15th August, and you will have a bumper crop. The natives in Lower Bengal cut and collect their bamboos from October to 15th April at the latest, and their clumps throw out 16 to 20 bamboos annually, whereas the forest clumps do not, as a rule at an average, send up more than 8 to 10. I do not mean a clump with 90 to 100 shoots, but what we daily see in the forest, say 30 to 50. An ordinary clump in Bengal with 20 to 30 bamboos will produce 16 to 20 shoots. The reason is simple enough—

1st. Those under cultivation in Bengal are improved by their owners picking out all dry bamboos and stools from the clumps, which care the forest clumps do not receive.

2nd. The clumps are not disturbed during the season of reproduction, which greatly deteriorates bamboos.

J. C. S. D. Mendes.

NOTES ON FORESTRY.

A comparative statement of the financial results of forest working in various countries which appeared in the September number of the "Indian Forester," has led me to enquire into the amount of the net revenue per acre, of the Cantonal forests of Vaud, Switzerland, my notes on which you were obliging enough to publish in a previous number.

I find that the average surplus revenue of these forests for the years 1884, 1885 and 1886 was £6,265 per annum. And the area of the forests being 24,500 acres, the net outturn works out to the satisfactory figure of 5 shillings and a penny per acre. I fancy that the proprietors of the 2,788,000 acres of woodland which are said to exist in the United Kingdom, would in these days of agricultural depression, be very well satisfied with such an all round surplus revenue.

As another piece of statistical information, I find that the price for wood sold in Switzerland, brushwood as well as timber being lumped together in the official report, was in the same years 12 francs 19 centimes per cubic metre, and as this is equal to 35·316 cubic feet, the average price obtained was only 34½ centimes, say *3d.* per cubic foot.

The Royal Asiatic Quarterly Review contains an interesting contribution to forest literature from the pen of Major General Michael, C.S.I., formerly in the Forest Department, Madras.

Nothing is being done, during the Parliamentary recess *re* the establishment of a Board of Forestry in Great Britain. In England the question of instruction in Forestry is considered a matter for Land Agents, to whom now-a-days this is of considerable importance. In Scotland, the demand is rather for an entirely separate class of men. And the amalgamation of these requirements will require delicate handling.

Notwithstanding the low price brought by rough timber in consequence of the large imports into the country induced by Free Trade—these imports were stated in the evidence given before the Parliamentary Committee to be of the value of sixteen millions sterling—growing plantations still retain an appreciable value. In the purchase money recently paid for an estate in this neighbourhood, the value of the woods, which had been carefully gone over by an expert, stood at the respectable figure of £24,000, an estimate which was accepted without demur.

ST. ANDREWS, N.B. GEORGE CADELL.

DEODAR REPRODUCTION.

IN 1884, I wrote giving results of observations made by me and others on the ripening of deodar seed, and at the end of my letter remarked as follows:—"I have observed that both old and new cones are found on the same tree; but never, so far as I could see, were there male flowers and new cones on one tree. I may be wrong, but so sure am I of this, that when looking for new cones, I simply observe whether the tree has male flowers on it or not," &c. Since then I have often looked at deodars in August and September for young cones, and at last in September I found a tree just behind and above the Bhandál forest bungalow, which had not only male flowers and ripe cones, but also the young cones; it is, however, evident that it very rarely occurs. In the beginning of the letter above alluded to, I mentioned that Sir D. Brandis had said that he felt sure he had seen half mature cones on the tree in autumn together with ripe cones, this is, in my opinion, quite impossible; but I have noticed what look like half mature cones, which on being broken turn out to be rotten cones, bored by insects, probably having never been impregnated with pollen; these are I fancy what he took for half mature cones.

J. C. McDONELL.

SEEDING OF BAMBOOS.

THE seeding of bamboos in Travancore which I mentioned in my letter of the 23rd July was not general all over the country. South of a certain line the seeding took place about a dozen years ago, and the bamboos there are now full grown. Isolated clumps in the cultivated parts also failed to seed.

The wool or elephant reed (*Beesha travancorica*) which covers large areas of forest land, especially at the higher elevations, seeded in 1875, and again over the same area in 1882, so that its period of maturity seems to be seven years.

TRAVANCORE, *October* 10*th*, 1887. T. F. B.